NATURE

No. 3813 SATURDAY, NOV. 28, 1942 Vol. 150

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Advertisements should be addressed to
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Telephone: Temple Bar 1942

The annual subscription rate is £4 10 0, payable in advance, Inland or Abroad

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ANGLO-AMERICAN RELATIONS IN RECONSTRUCTION

THERE can be few who would not agree as to the importance of intimate co-operation between the United States and Great Britain both in winning the war and in winning the peace, though there are clearly some who are dubious as to the feasibility or durability of that co-operation. The agreement between Great Britain and the United States signed last February, and the exchange of notes during September on the principles applying to mutual aid and to reciprocal aid, set forth some of the ways and means by which this essential co-operation may be made effective.

As Mr. Harold Butler has pointed out in an article in *Agenda*, written before he left for Washington to take charge of British information services there, the far-reaching importance of these latter documents has scarcely been generally realized. In particular, the enumeration in Article 7 of the Agreement of February 23 of the principles upon which a settlement of the Lease-Lend account is ultimately to be concluded, which is the essential part of the agreement, has been commonly overlooked. The subsequent exchange of notes detailing the terms on which war supplies and services are to be exchanged, carrying the lease-lend policy a stage further, tends to divert attention yet more from these principles. Yet it is all to the good that this latter document should make it so plain that lease-lend supplies have long ceased to be a one-way traffic eastwards across the Atlantic. There has been considerable exchange of scientific information, but it is to be regretted that the censorship in the United States has operated in such a way as to delay or prevent the transmission abroad of a journal such as *Science* and of individual articles in other scientific journals, thereby impeding the flow of information.

There can be no question as to the soundness of laying down so far as possible the principles upon which reciprocal aid is applied in the prosecution of the War. That is one of the surest methods of eliminating misunderstandings or any friction which may be engendered by arbitrary or injudicious handling either of the censorship or other matters. We may count on Mr. Butler to continue in Washington that invaluable work of interpretation and exposition to which he addressed himself in Great Britain.

The principles upon which a final settlement is to be concluded may be briefly summarized as follows: First, the terms "shall be such as not to burden commerce between the two countries". Secondly, their aim is not merely the promotion of Anglo-American trade, but also "the betterment of world-wide economic relations". Thirdly, the methods by which this goal is to be sought are: (*a*) through "the expansion, by appropriate international and domestic measures, of production, employment, and the exchange and consumption of goods"; (*b*) through "the elimination of all forms of discriminating treatment in international commerce"; and (*c*) through "the reduction of tariffs and other trade barriers". Fourthly, participa-

tion in agreements to this end shall be open to "all other countries of like mind".

Mr. Butler considers that this agreed statement of aims may prove a decisive factor in the development of Anglo-American relations. Agreement in the view that the key to a comprehensive economic settlement is to be sought in an expansionist policy immensely facilitates the discussion of the thorny problems which will have to be solved. A big step has been taken towards assuring the co-operation of the two countries during the difficult period of international reconstruction. Great Britain and the United States are pledged to a joint effort in building a new world economy. The major responsibility in European restoration must indeed fall on Great Britain, but we cannot give the lead and secure the co-operation of our allies, and not least of the Soviet Union, without thinking on an international scale and creating international machinery.

These agreements pledging Britain and the United States to work together with a common plan and a common ideal provide us with the means of forging a powerful weapon in the war of ideals. As the outline of a better society begins to take shape, holding the promise not only of national freedom and individual liberty, but also of greater social security based on economic prosperity, the United Nations will fight with redoubled energy. The Anglo-American agreements may well be developed into the programme of a new international order, adding fresh driving force to the faith of the United Nations ; and the remarkable series of speeches in recent months by leading men of the American administration, from the President downwards, shows the extent to which a new idealism has already gripped the minds not only of economists, sociologists and scholars, but also of statesmen. Mr. Henry Wallace's thought of "the century of the common man" rather than of "the American century" has clearly caught the imagination on both sides of the Atlantic.

These speeches of Mr. Wallace, Mr. Sumner Welles and Mr. Cordell Hull are of importance as indicating the beliefs upon which the American conception of a new order rests. Mr. Hull indeed has laid down the principles of a broad programme of world economic reconstruction in direct opposition to the programme outlined by the Nazis, and it pre-supposes an attempt to combine economic liberty with economic order. He repudiates excessive trade restrictions or discrimination in international commercial relations. Raw materials must be available to all nations without discrimination. International agreements regulating the supply of commodities must be handled so as to protect fully the interests of the consuming countries and their peoples. The institutions and arrangements of international finance must be set up so that they lend aid to the essential enterprises and continuous development of all countries, and promote the payment through processes of trade consonant with the welfare of all countries.

This programme and these principles have far-reaching implications, including the condemnation of past trade policies of Great Britain and of the United States. It will be noted how far in harmony they are with the new colonial development policy which has been initiated since the outbreak of war, and with the outlook on this topic of Lord Hailey and others in Great Britain. What must be realized, however, is the importance of the American approach and the American proposals being clearly understood in Great Britain. As Mr. Butler says truly, the active prosecution of British thought on reconstruction is a war-issue as well as a peace-issue.

Neither in the United States nor in Britain, in fact, can our thought about reconstruction, whether internal or international, be confined to purely national considerations or calculations. Naturally enough, much more thinking on post-war problems has been done during the last two years in the United States, but the concern which Lord Reith and, more recently, Lord Latham have expressed in the House of Lords at Government delay in dealing with the findings of the Scott and Uthwatt Committees, and in providing the essential machinery for planning, is not entirely a domestic issue. It inspires criticism abroad which may not always be fair, but such dilatoriness towards planning is a handicap to good Anglo-American relations, as is very clear from Mr. Butler's article.

The debate in the House of Lords on November 18 and 19 arose out of a motion by Lord Latham urging the Government to introduce without delay the legislation necessary to make possible preparatory steps, so that actual planning and reconstruction may begin as soon as hostilities cease, and referred only to reconstruction in Great Britain. It produced statements from Lord Portal, Minister of Works and Planning, and the Lord Chancellor, respectively, the tenor of which was to show that the Government is actively engaged on the many intricate problems involved, while Sir Stafford Cripps in the House of Commons promised legislation during the present session. Clearly we must put our own house in order before we can approach other countries.

In this connexion the report of the U.S. National Resources Planning Board on National Resources Development in 1942 should not be without interest in Great Britain. Its review of public works planning is concerned with particular programmes in the United States, but the functional development policies described in Part III of the document are of wider interest. They show how the problems of industrial location, of transport, of the utilization of special skills, of urban conservation and development, of planning for social security, and post-war planning for children and youth, are being faced in the United States.

The introduction and first part of this report, however, are of special interest as indicating the approach of the United States to these problems. The clarification of our objectives for the onward march of freedom-loving people is seen as an essential part of the war-effort. The report looks forward to securing, through planning and co-operative action, a greater freedom for the American people, and the introduction suggests that any translation of freedom into modern terms applicable to the United States must include: (1) the right to work, usefully and creatively, through the productive years ; (2) the right to fair pay,

adequate to command the necessities and amenities of life in exchange for work, ideas, thrift and other socially valuable service; (3) the right to adequate food, clothing, shelter and medical care; (4) the right to security, with freedom from fear of old age, want, dependency, sickness, unemployment, and accident; (5) the right to live in a system of free enterprise, free from compulsory labour, irresponsible private power, arbitrary public authority and unregulated monopolies; (6) the right to come and go, to speak or to be silent, free from the spyings of secret political police; (7) the right to equality before the law, with equal access to justice; (8) the right to education for work, for citizenship, and for personal growth and happiness; and (9) the right to rest, recreation and adventure; the opportunity to enjoy life and to take part in an advancing civilization.

The central problem is one of freedom and the distribution of abundance, so that there may be no unemployment while there are adequate resources and men ready to work and in need of food, clothing and shelter. The obligations which go with such rights are also recognized. The preliminary objectives are visualized as planning for full employment without demanding hours in excess of forty per week or fifty weeks in the year, using to the utmost a system of modified free enterprise. The planning of demobilization and the stimulation of planning by private enterprise, including the study of the consumer market, of industrial location and of management, the relation of Government to private enterprise, schemes of public works, transport and land development, and the extension of such services as health, nutrition and medical care, all find a place in the programme, and the section on international planning indicates that American thought is well prepared for the responsibilities in European reconstruction outlined in a recent pamphlet issued by the Royal Institute of International Affairs.

That thought on reconstruction in Great Britain and in the United States should be on such similar lines is not surprising. It was an Englishman who put the case for the Colonies before his countrymen in the House of Commons better than any of their spokesmen did before the Colonists themselves. The passage of more than a century and a half has not weakened the strength of the heritage and ideals which the Anglo-Saxon democracies share. The ordeal of war has rather intensified their meaning, and Burke's words, like Jefferson's declaration, come down to us with fresh meaning and assurance of the grandeur of that common heritage. The mixing up of the two great democracies under the strain of war, the perils shared and the new comradeship in arms and in production, should assuredly lead to a fuller understanding that will promote accord and comradeship in the no less searching tasks that lie ahead in building and maintaining the peace. It is the duty of every citizen, of scientific workers no less than others, to see that every opportunity of fuller understanding is grasped and that the obstacles to co-operation, whether in peace or war, like the misunderstandings which lead to friction, are firmly and persistently swept away.

TIDES: THEORY AND PREDICTION

Admiralty Manual of Tides

By Dr. A. T. Doodson and Comdr. H. D. Warburg. Pp. xii+270. (London: H.M. Stationery Office, 1941.) 12*s*. 6*d*. net.

THE numerous and important developments in our knowledge of the tides that have been made in recent years are largely hidden away in technical journals. There has been but little written for those who wish to know something of the tides and their causes without working through the heavy mathematics which usually surrounds the subject. G. H. Darwin, in his "Tides and Kindred Phenomena", published in 1898, gave a clear non-mathematical account of the subject as it was then. Public interest in the theory of the tides was shown by the demand for further editions in Great Britain and by its translation into several foreign languages. Warburg's "Tides and Tidal Streams" (1922) was intended for seamen and for those who require a professional knowledge of the tides; but it contains a description of the chief tidal features in a form suitable for the general reader. Marmer's "The Tide" (1926) is a simple and readable account of the subject and includes references to the more recent work. In addition, many text-books of geography and allied subjects have devoted a chapter to a more or less sketchy account of the tides and their causes. But there is clearly room for a book, which, while it does not avoid mathematics altogether, yet steers a middle course between the formal treatise and the popular account for the non-scientific reader, and also incorporates the developments of the last thirty years. Such a book is the "Admiralty Manual of Tides".

The book is written with a dual purpose. It is first to give a scientific account of the tides for the use of hydrographic surveyors and naval officers, and to give it in such a form that it may be readily applied. For such, it is necessary to include some mathematics, though not more than is covered by elementary algebra and trigonometry. Secondly, for those who wish to avoid mathematics, there is a connected account, based principally upon geometrical diagrams, that is complete in itself. The mathematical paragraphs are marked with asterisks and can be skipped without vitiating the main argument. The diagrams are numerous and ingenious, and no pains have been spared to make clear the various points.

There are two main lines of investigation in tidal science. The first is practical in its outlook and intention. In it, series of observations of tidal motions are made for each port under consideration. These observations are reduced to suitable form, and from this, tide tables for the future are deduced. The most successful method of reduction is that proposed by Kelvin, the harmonic analysis of the tide into its fundamental components. Recently, this method has been much improved in form and has been extended to include shallow-water and other components which formerly impaired the accuracy of the predictions. Little theory enters into this part of the subject, except the broad principle that component periodic forces in general produce oscillations of corresponding periods in a dynamical system, though with possibly different amplitudes and phases. The method has achieved great success, as is seen in the remarkable degree of accuracy of current tide tables.

The second aspect of investigation is more ambitious and much less successful. In its ideal form it attempts, by use of the law of gravitation, and the laws of fluid motion, together with a knowledge of the contours of the ocean beds, to predict what the tides should be, without making any use of observations. In this it resembles the planetary theory of dynamical astronomy. Needless to say, the contours of the ocean beds being what they are, the problem in its general form seems impossible to solve. Some progress has, however, been made by substituting oceans of simple geometrical forms; and the tidal features of oceans bounded by vertical cliffs along meridians of longitude or parallels of latitude have been deduced. A further simplification, suitable to the cases of seas of small area, is to neglect the sphericity of the earth. Some cases of this type have been solved, giving results of great interest.

Both aspects of tidal investigation are treated in this book. The first part deals with the methods of recording the tides, and the methods old and new, non-harmonic and harmonic, of tidal prediction. While the complete processes of harmonic analysis and synthesis are necessarily used in the formation of published tide tables, it is frequently necessary to determine the high and low tides for a particular day, or the tides at various times of a day, when tide tables are not available. The authors of this book have devised a method of prediction, of the greatest simplicity and of considerable accuracy, which can be used whenever the harmonic constants M_2, S_2, K_1, O_1 appropriate to the place are available. By a judicious system of approximations based partly upon the equilibrium theory and partly upon experience, and by suitably prepared reference tables, other components than those mentioned are incorporated in the result. Arrangements are also made to include shallow-water components wherever these are significant. This method, though incorporating the mixed semi-diurnal and diurnal tides, involves very little computation. The actual work can after practice be carried through in a few minutes. Its success may be judged from the following results:

For Dover, March 25, 1936,

High water	Predicted	0h. 9m., 20·4 ft.;	12h. 28m., 20·4 ft.
	Observed	0h. 4m., 20·2 ft.;	12h. 26m., 19·8 ft.
Low water	Predicted	7h. 34m., −1·6 ft.;	19h. 53m., −1·6 ft.
	Observed	7h. 46m., −1·4 ft.;	19h. 58m., −1·4 ft.

To those who know the difficulties of the subject, these figures require no comment. The authors have given to the process the name "Admiralty Method". It was originally published in 1936, but does not seem to have received the attention it deserves.

The second part of the book deals largely with the theory of waves as applied to the tides. In this connexion the rotation of the earth is of importance, and a full account is given of Kelvin waves and combinations of them producing amphidromic systems. The application of such systems together with essential tidal observations has resulted in the successful tracing of the progress of the semi-diurnal tide in the seas about Great Britain.

The history of co-tidal maps of the British seas is interesting. The first map, due to Whewell (1836), showed a wave in the North Sea travelling down the east coast of Britain and northward up the Dutch coast. In the Flemish Bight he actually exhibited an amphidromic system, though this was not accepted as a possibility at the time. Airy in 1845 eliminated this amphidromic system and replaced it by tidal waves crossing each other in a somewhat inexplicable manner. In the English Channel, too, Airy insisted that the co-tidal lines must be curved, the speed of the waves being supposed greater in mid-channel than along the coasts, a theory that was later proved impossible. In 1904 Harris produced co-tidal maps showing an entirely different form of the co-tidal lines in the English Channel and the Irish Sea. These show degenerate amphidromic systems very close to the forms now accepted. Harris also found an amphidromic point off the south of Norway in addition to that in the Flemish Bight. Tizard's chart published in "Tides and Tidal Streams" (1909) represents an amphidromic system in the Flemish Bight, but rather remarkably makes it appear to require two tidal periods for the wave to circulate about the no-tide point instead of one! A further improvement was made by Sterneck in 1920, who got still nearer to the correct forms.

In preparing all these charts the authors mentioned above relied on coastal observations alone and ignored the extensive knowledge of the tidal streams which then existed. From 1924 onward, Proudman, Doodson and Corkan, utilizing all available observational data, and checking them against the simple formula which connects the tidal current with the surface gradient, have produced charts of the complete system of the semi-diurnal tide in the British coastal waters. This is now published as an Admiralty chart, and is probably the first of its kind to be produced in which speculation plays no part and of which all available evidence demonstrates the correctness.

The explanation of the occurrence of the three amphidromic systems which appear in the co-tidal chart of the North Sea can be made intelligible without recourse to any form of mathematics. This the series of seven diagrams in Chapter 25 does with great clearness.

A common theory found in nearly all text-books is that the principal tidal wave is generated in the Southern Ocean, that ocean, surrounding the globe, being considered the only place where the tide-producing forces can be completely effective. The tidal waves of the Atlantic Ocean, the Pacific Ocean and the Indian Ocean, are regarded as secondary waves derived from the Southern Ocean and not as waves produced by the tidal forces within these areas themselves. Against this view, almost seventy years ago, Ferrel, after a study of the Atlantic tides, decided that "if there were a dike extending from the Cape of Good Hope to the coast of South America, the tides of the North Atlantic Ocean would most probably be very nearly the same". The results of recent investigations show that the Atlantic tides, far from being secondary waves, are produced within that ocean itself, and that their magnitude is due to approximate resonance with a free period of oscillation. In a set of diagrams the authors show the co-tidal systems of the semi-diurnal tide in a series of oceans bounded by two meridians at different distances apart. These diagrams help to indicate the kind of tidal motion that may be expected in the Atlantic Ocean or the Pacific Ocean.

The double high water at Southampton, so important to the commercial prosperity of the port, has always been a matter for ingenious speculation. A favourite theory is that the phenomenon is due to the main tidal wave from the Atlantic reaching Southampton by two routes, one via the west and the other via the east of the Isle of Wight, the time

difference of two hours being accounted for by the longer passage of the eastward route. Although this theory was certainly scotched by Airy a hundred years ago, and may have been exposed earlier, the idea still persists. Indeed only a few weeks ago it was broadcast by a member of the B.B.C. Brains' Trust as an established fact! The problem is fully discussed by the authors, and by simple analysis it is exhibited, as it really is, as the semi-diurnal tide modified by shallow-water tides. The point of interest which comes out, and which remains still a mystery, is why the shallow-water components should be so adjusted in magnitude and phase as to give exactly a double high water at Southampton, and yet a double low water at Portland.

The chapter on "Bores" is worked out on very simple lines. By use of Bernoulli's integral and the equation of continuity, it is possible easily to explain the main features of tidal bores and the conditions necessary for their existence.

Many other matters of interest might be commented upon, but enough has been said to indicate the scope and character of the book. It is a work which will have great value and influence in schools of navigation and geography, and will prove interesting reading for those who seek knowledge for its own sake. It removes many fallacies and misunderstandings which have persisted, and it presents the subject in a new and clearer light, at once interesting and correct.

G. R. GOLDSBROUGH.

AN INTRODUCTION TO ECONOMICS

The Social Framework

An Introduction to Economics. By Prof. J. R. Hicks. Pp. xii+212. (Oxford: Clarendon Press; London: Oxford University Press, 1942.) 7*s*. 6*d*. net.

A NEW way of handling elementary economics is badly wanted—a really new approach to the subject which will bring it into living connexion with contemporary realities. The traditional 'shape' of the subject, worked out during the second half of the eighteenth and the first half of the nineteenth century and thereafter modified only in detail, was the product of an age which had, except in the realms of foreign trade and public finance—and even there the data were scanty and often misleading—no statistical basis for study of the essential facts. This is not the sole explanation of the highly abstract and deductive methods which were employed by the classical economists; but it is a large part of the explanation. Their successors took over from them the apparatus they had devised, and have in the main continued to use it right up to the present time, partly because it had acquired a certain sanctity as the biblical justification of free trade and *laisser-faire*, and partly because it provided the readiest means of teaching economics as an academic subject, without too much soiling of the brain by contact with the sordid doings of the business world.

Gradually, this older body of economic teaching has been losing its hold. Some economists have been breaking more or less thoroughly away from it, and relying more and more on study of actual statistics rather than on abstract reasoning, while others, despising such studies except as occasional diversions from a higher task, have retired into the realm of mathematics and there built for themselves the most exquisite fairy castles of refined theory, with barely a rainbow road to connect them with the real world. Prof. Hicks himself has been a wanderer in this fairy kingdom; but now he has come back with a swift descent to the countries where things are actually bought and sold, and has presented us with an elementary text-book of economics considerably unlike other text-books and, for the beginner, very much easier to read and understand. It is true that he half promises a sequel, which will lead his readers back to the fairy kingdom, for which he has by no means lost his affection or his respect. But experience in actual teaching of elementary students seems to have taught him, as it might long ago have taught others, that the abstractions of the theory of value and of 'equilibrium economics' are not the most favourable ways of entry to the subject for the ordinary learner.

I think one reason why this lesson has not been more readily learnt by economists is that the abstract approach, deterrent as it is to the less clever students, does hold out high prizes to the clever. If a student has a high-class logical or mathematical brain, and enjoys logical or mathematical exercises, he can get a very long way very quickly in the fairyland of economic abstractions, without being in any degree held up by his ignorance of the real world; whereas, if he attempts a realistic approach, he is liable to be continually brought up against his lack of acquaintance with the facts he is trying to arrange into some sort of order. Prof. Hicks has tried to avoid this difficulty by eschewing entirely facts which have about them any taint of technique, with the consequence that his book says a lot about wages, profits, capital, shares, joint stock companies, and other things which anybody can understand, but very little about industry or production, save in the most general terms. Prof. Hicks would perhaps argue that such things belong to the realm of technique, or of applied economics, and not to the elements, with which alone he is concerned in the present volume; but I find the effect a little lop-sided. The question of monopoly, for example, is practically not dealt with at all, though it is surely vital.

All the same, I am in general very grateful to Prof. Hicks for what he has done. On the whole, I think he has rather overdone the simplicity, and sheered off certain subjects which he could have treated in a reasonably elementary way—notably money and the wide questions of the relations between the volume of employment and production on one hand and the distribution of income and the levels of consumption and investment on the other. Nor can I feel happy about a book on elementary economics from which the notion of 'margins' is practically absent; for though much evil has been done in the teaching of 'marginal' doctrines, the conception is one which has a necessary place in the study of real economic processes, even at a quite elementary level. These criticisms, however, are not meant to amount to a denial of the high value of what Prof. Hicks has achieved.

What has he done? He has produced a book which is well designed to serve two purposes—to keep his students interested, including his less clever students, and to send them on to study economics with a good idea of what it ought to be about and of the way in which statistics can be handled in the course of studying it. His book is, in the words of his sub-title, "an introduction *to* economics", rather

than an elementary text-book *of* Economics—and I imagine that is what he intended it to be.

I have no space to deal with particular points, save in a sentence or two, though there are many on which I should like to comment. I do not like his unargued acceptance of economics as a 'science', or share his view of the progress which it has made. I think he treats the population problem too much in terms of mere quantity, and too little in terms of quality. I think he uses the word 'profits' ambiguously, as so many economists do. His equation of consumers or customers with employers seems to me misleading; and I think his omission of most of the problems of monopoly vitiates his treatment of the questions of capital ownership and control, which is in other respects refreshingly realistic. I could add many similar points of criticism; but, unexplained, they would serve no useful purpose, and would convey a misleadingly hostile impression of what I regard as a very useful and timely little book.

G. D. H. COLE.

A DYER IMPARTS HIS KNOWLEDGE

Dyeing with Coal-Tar Dyestuffs

The Principles Involved and the Methods Employed. By C. M. Whittaker and C. C. Wilcock. Fourth edition. Pp. vii+371+10 plates. (London: Baillière, Tindall and Cox, 1942.) 16*s*.

THE term 'chemical industries' in its wider significance comprises all those manufactures in which the formation of the products sold depends on chemical interactions and is certainly not confined to the manufacture of chemicals. All these industries, in reality based on chemicals, though still prone to pay lip service to the 'arts and practice' of their calling, are having to admit the scientific man into their management. It was Davy who wrote in 1802 that the arts of bleaching and dyeing, which the habits and fashions of society have made important, are purely chemical.

Since then a number of men with honoured names have brought chemistry into the dye house, writing books whereby their knowledge might be imparted to others. The latest of these books is from the pen of C. M. Whittaker, who for forty years has done as much as anybody both in discovery and in the application of his chemical knowledge to a very ancient art. Incisive in speech, he writes clearly and to the point, and he and Mr. C. C. Wilcock are to be congratulated on a most useful production.

This is a fourth edition; it appears only four years after the third, a fact which may be taken to mean renewed interest in dyeing under war conditions. One of the sales methods adopted by continental competitors was to give much assistance in the dye house of a customer conditional on the purchase of foreign dyes. The acceptance of this help has proved a short-sighted policy.

Dyeing in the old days used to be a question of cotton, silk and wool. Now new fibres of several kinds have arrived, which may be the forerunners of a legion, and the dyer is faced with new responsibilities. The production of Rayon yarn and staple fibre now amounts to about one sixth of that of cotton, though the increase has not been at the expense of cotton or wool. The production of silk has fallen and may well continue to do so.

Eight of the chapters deal with specific coal-tar dyestuffs, in the divisions which are customary. New sections deal with the structure and identification of textile fibres, with the preparation of textile materials for dyeing and with the principles of dyeing machinery. Some of the older sections have been re-written and all have been brought up to date, for the subject of dyeing is anything but static.

Dyeing in Great Britain has a great post-war future. There will be millions of new homes to be furnished and there is both opportunity and urge to make the textiles colourful and of good design. Let us hope the industry will be made an all-British one, free from Continental influence; with leaders such as Whittaker available there should be no difficulty.

E. F. ARMSTRONG.

WAR-TIME FARMING IN BRITAIN

Farming Handbook

By Sir E. J. Russell, Dr. H. D. Kay, Dr. W. G. Ogg, B. T. P. Barker, Malcolm Messer, Geoffrey Browne, F. H. Garner, J. A. McMillan, T. Nellist Wilks, Dr. E. Holmes, W. R. Orrell, and other Experts. Pp. iv+220+52 plates. (Norwich: Jarrold and Sons, Ltd., 1942.) 5*s*.

CONDITIONS under which farmers have to carry on their business have changed so much in the last three years that a collection of articles by well-known specialists on the most important technical aspects of agriculture is particularly welcome. The approach to the various problems of production has been influenced by the complete change in the situation in Great Britain as regards the proportion of land under the plough, the very small amount of purchased feeding stuffs available, control of the purchase and use of fertilizers, etc. An authoritative handbook of this kind helps efficient farming by presenting essential and up-to-date information drawn not only from the results of experiments and research but also from the experience of war-time farming.

The first contribution is by Sir John Russell, on crop production in war-time. This brings together the results of many experiments on different crops, and discusses a few of the more important pests and diseases of cereal crops. The article is particularly useful, written, as it is, by a scientific man with a keen sense of the significant; there is in it no material of purely academic interest. Among other contributions are articles on dairy farming in war-time, by Prof. H. D. Kay, and feeding farm livestock in war-time, by F. H. Garner, which provide the reader with the necessary information for the successful management and feeding of the dairy herd, and of farm livestock in general. The former includes a discussion on the technique of milk production, and on disease in relation to production. Other articles, also rich in practical advice, are concerned with fertilizers, fruit growing, land reclamation, farm machinery, etc.

All the contributions deserve mention, but this is impossible within the space of a short notice. Practical men, potato growers in particular, may be forgiven for starting the book by reading the contribution on potato cultivation on a large commercial scale, by G. F. Young, manager of Messrs. Smith's Potato Crisps farms; it is good, and savours of a wealth of experience gained by an observant grower.

The book is illustrated, and is well printed on good paper. It can be recommended to farmers, scientific men, and to technical and other members of War Agricultural Committees.

Torch and Crucible

The Life and Death of Antoine Lavoisier. By Sidney J. French. Pp. x+285. (Princeton, N.J.: Princeton University Press; London: Oxford University Press, 1941.) 21*s*. 6*d*. net.

LAVOISIER, founder of modern chemistry, and one of France's greatest sons, has formed the subject of many biographical studies. Some of these have dealt mainly with his scientific achievements, others with his place in history. Mr. French has been very successful in his attempt to give a complete synthesis of this versatile and commanding figure in pre-Revolution France. Here we see Lavoisier not only as the inspired creator of a new chemistry, but also as one whose "active mind co-ordinated scientific genius, business efficiency, political vision, and public benefaction in a perfect harmony of tone". His domestic, social and political backgrounds are clearly outlined in the course of an easy, attractive—and, at times, dramatic—narrative; so are his relationships with Priestley, Cavendish (who is wrongly mentioned on p. 146 as "Lord" Henry Cavendish), and a galaxy of scientific men of his day.

The general reader should extract almost as much pleasure from this book as his scientific friends, and that is saying a great deal. Effective humanistic studies of the great figures of science are rare, and we owe a debt of gratitude to such writers as Mr. French. The appearance of this new study is a welcome herald of next year's bicentenary of Lavoisier's birth. The production of the book is sumptuous. The sole illustration is a charming reproduction on the paper jacket of David's painting of M. and Mme. Lavoisier. Unfortunately, the high price may prevent the book from attaining the wide circulation that it deserves among the lay public. J. R.

Magic and Natural Science in German Baroque Literature

A Study in the Prose Forms of the Later Seventeenth Century. By Frederick Herbert Wagman. (Columbia University Germanic Studies, No. 13.) Pp. vii+178. (New York: Columbia University Press; London: Oxford University Press, 1942.) 15*s*. 6*d*. net.

IN this richly documented work, the author shows to what extent the German intellectual laity were influenced by contemporary scientific men, such as Galileo, Kepler, Bacon, Pascal and Jungius. The principal lay writers considered are Daniel Casper von Lohenstein, Georg Philipp Harsdörfer, the author of forty volumes of poetry and prose, Eberhard Werner Happel, the author of twenty "gallant" novels and a five-volume work on the wonders of the world, Erasmus Francisci, the compiler of compendia of curiosities, Christian Weise, an opponent of the scholasticism of German universities, Johann Riemer, Johann Beer, the author of eighteen novels and one of the most gifted writers of the seventeenth century, and Johann Christoph Grimmelshausen, the author of "Simplicissimus" and representative of Christian asceticism. The influence of the scientific writers of the age appears to have had various effects. In the first place there was a waning of medieval belief in miraculous intervention in Nature and the theological interpretation of phenomena, although remnants of occult lore were still present. Secondly, a dominant rationalistic tendency was shown by the belief that Nature is autonomous in its control over mundane and sidereal phenomena and free from intervention by either divine or diabolic agency.

Ethnographic Bibliography of North America

By George Peter Murdock. (Yale Anthropological Studies, Vol. 1.) Pp. xvi+168. (New Haven, Conn.: Yale University Press; London: Oxford University Press, 1941.) 12*s*. net.

THIS first number of a new series of anthropological studies sets a high standard for its successors. The author of the bibliography has been engaged in its compilation on and off for about twelve years and the result is comprehensive and most useful, covering as it does the aboriginal population of the whole of North America. The principle of classification by tribal groups was adopted, the norm being the "nationally self-conscious tribes of regions with some measure of political development, e.g., those of the Plains". Where this standard could not be obtained a number of tribelets or local groups on approximately the same linguistic or cultural plane were united under the name of one of them.

The difficulty of charting these divisions on a map was increased by the shifting of the tribes during three centuries, which necessitated a number of compromises. The boundaries shown are approximately those of the various groups at their first extensive contacts with Europeans, and thus they are not all valid at any single period, but represent a shifting date line.

The work is organized by areas, each containing general references followed by areal references to the tribes in alphabetical order, and comprising works on physical anthropology, linguistics and archæology, as well as the more general ethnological works. The whole contains an astonishing bulk of literature dealing exhaustively with the anthropology of the whole sub-continent. K. RISHBETH.

The Furtherance of Medical Research

By Dr. Alan Gregg. (The Terry Lectures.) Pp. x+129. (New Haven, Conn.: Yale University Press; London: Oxford University Press, 1941.) 12*s*. net.

DR. ALAN GREGG, the distinguished director for medical sciences of the Rockefeller Foundation, has presented us with a thoughtful and stimulating work in the form of three lectures devoted respectively to a description of medical research, universities and foundations in relation to such research, and the medical research worker. In the first lecture he points out that research in any field comprises a series of activities consisting in selecting, observing, recording, comparing, analysing and classifying phenomena and finally drawing suitable conclusions, each of which contributes to, but cannot be substituted for, the whole process. In the second lecture Dr. Gregg maintains that, compared with a Government's subsidizing of research, foundations can much more easily work outside national boundaries and support the demonstration of theories which are not sufficiently widely accepted to qualify for Government support. Moreover, foundations can pay larger salaries than a Government is capable of doing. The third lecture contains a sympathetic account of the uphill struggle of the young research worker.

There are two appendixes consisting respectively of an outline docket film and an outline for presenting a proposal for a capital grant for building an institute.

INTERNATIONAL SYSTEMS AND STANDARDS*

By SIR RICHARD GREGORY, Bt., F.R.S.

THE Great Exhibition of 1851, in Hyde Park, London, was the pioneer of international exhibitions, and it demonstrated the industrial resources of the nations which took part in it as well as the extent of world markets in them. The International Exhibition held in London eleven years later led to the formation of the International Working Men's Association, now known as "The International", at a great public meeting in 1864 of artisans from many countries, and thus brought conditions of labour into the economic field. In the following year an International Telegraph Convention was held to regularize systems of transmitting telegraphic signals, and in 1874 the General Postal Union was formed. These were the beginnings of international trade associations, unions and relationships. The Postal Union is the best example of organization of systems and standards on an international basis. For its service the world is the unit and there are no separate territories or boundaries.

It is necessary for manufacturers to adopt and maintain standards of measurement for their products, whether for domestic or for foreign trade. Standardization within and between industries leads to better understanding and co-operation in the common interests of the producer and the consumer. It is increasingly important for the maintenance and development of foreign trade and is the best means of ensuring fairness of exchange and facilitating industrial operations. After the War of 1914–18, one of the outstanding developments in the chief industrial countries, and perhaps more particularly in Great Britain and the United States, was that of co-operation in standardization of products of allied or related industries on a national scale.

So far back as the beginning of this century, a small group representing civil, mechanical and electrical engineering was set up in Great Britain as the British Engineering Standards Association, which was incorporated by Royal Charter in 1929 and is now the British Standards Institution. There are two kinds of standardization—one concerned with fundamental standards and units of measurement, and the other with the rather wider field of industrial simplification and uniformity. The latter involves the adoption of standard specifications of material and method in all branches of industry where they can be usefully applied; and they are constantly being added to and revised to meet new industrial needs.

For inter-Imperial trade it is desirable to have common agreement upon standards of measurement based upon the British system of weights and measures. The British Standards Institution exists to ensure this uniformity of principles and practice of standardizing bodies in all parts of the Empire. It has also the duty of converting British standard specifications into those of other countries having standardized systems, in order to facilitate foreign trade. As, however, the tendency for many years has been towards the adoption of the metric system in new industries, and this system is already used in most countries of the world, there is every reason to believe that it will become truly international in its service and that national and Imperial standards will have to be adapted to it for purposes of world trade. In recent years the scope of the work of the Institution has been very greatly enlarged, and at the present time it covers much work on rationalization and simplification, with special reference to war-time needs in relation to materials in short supply and the use of substitutes.

The use of scientific principles as the basis of measurement came under consideration in the early days of electrical engineering. A century ago there was no settled system for the measurement and statement of electrical quantities, and all electrical measurements were merely comparisons between magnitudes of the same kind. The resistance of one conductor could be compared with that of a particular piece of wire and the electromotive force of one battery could be compared with that of another, but there were no recognized relationships between these quantities or fundamental standards to represent them. The German physicist, W. E. Weber, conceived the idea of expressing the value of any electrical quantity without reference to any quantity of the same kind, and in terms not involving any physical constants except the units of length, mass and time.

The British Association took up the subject in 1861 at the suggestion of Lord Kelvin, and the result of reports of its committee was the establishment of the coherent system now adopted everywhere in science and engineering. After much discussion and correspondence, it was decided to adopt the centimetre, the gram and the second as the primary units of length, mass and time to which the various quantities used in electrical measurements could be referred. This is the c.g.s. system, and all values of electrical quantities are expressed in these units. For practical purposes, standards of electrical resistance, current, electromotive force and power have been adopted by international conferences as particular magnitudes of the centimetre, gram and second. Germany, France, Italy and Great Britain are respectively represented in the names of these fundamental electrical units by ohm, ampere, volt (Volta) and watt.

Several years ago, Prof. G. Giorgi, of the University of Palermo, proposed a new system of electrical units based upon the metre, kilogram and second (the M.K.S. system), and the International Electrotechnical Commission recommended in 1938 that this system should be adopted in all countries. The system is in no way antagonistic to the c.g.s. system, and for instructional and practical purposes it has decided advantages in simplifying relationships between fundamental electrical, mechanical and magnetic units.

In science, and to an increasing extent in engineering, measurements are usually expressed in the international units of length, mass and time. For each of these fundamental quantities it is necessary to have a primary standard of reference. The primary standards of length and mass are kept at the International Bureau of Weights and Measures at Sèvres, near Paris. They are the International Prototype Metre and the International Prototype Kilogramme. The centimetre is 1/100 of the standard metre, and the gram 1/1000 of the standard kilogram. The standard international unit of time is one second, or the 86,400th part of the mean solar day.

With the introduction of railway systems, a standard time had to be adopted for the time-tables of trains. In Great Britain the standard time adopted

* From an address to the Association of Special Libraries and Information Bureaux, delivered on November 7.

was that of Greenwich; in the United States, where local times differ by several hours from one another, it was impracticable to use a single time standard for the whole country. The running of long-distance trains in times which differed greatly in different States was so confusing that a remedy had to be found; and it was produced by a Scots Canadian, Sir Sandford Fleming, in 1878. His proposal was to legalize a universal day, beginning at mean noon of Greenwich time, the hours being counted 0 hour to 24 hours. A few years later a conference held at Washington approved the adoption of a single prime meridian, and also Sir Sandford Fleming's principle of dividing the whole earth into twenty-four time zones, each separated from the next by one hour. This zone system of daily time reckoning on a uniform and universal plan has become truly international and has superseded by fixed standards the medley of prime meridians and local times which kept peoples apart and hindered the development of their common interests.

The division of the whole interval of day and night into twenty-four parts or hours, each of which was subdivided into parts like minutes and seconds, goes back to Babylonian times six thousand or so years ago. (The division of the angles in a circle into 60 by 60 or 360 degrees has the same origin.) The day and the night were each given a duration of twelve hours, but the lengths of the hours differed locally and with the seasons. With the introduction of clocks, it became necessary to establish a standard time interval independent of the varying lengths of the local day from one solar noon to the next. The average interval between successive noons became this standard as the mean solar day, which is the common day of civil life, and gives rise to mean solar time, or mean time. From about the end of the eighteenth century, mean time has been used in most countries instead of local solar time.

The standard time of a country or region is reckoned from a particular meridian, as it would be confusing to use a number of mean local times. Since the adoption of the zone system, standard times are referred to twenty-four meridians separated from Greenwich by a certain number of hours, with the zero hour at midnight and reckoned up to twenty-four hours, or in Great Britain up to twelve hours ante-meridian and twelve post-meridian. For practical purposes, the rotation of the earth upon its axis is invariable, and so is that of the second, or 1/86,400 part of a day, derived indirectly from it. The unit measure of time is, therefore, the same in all countries.

Various standards of measurement of length and mass (or weight) are in everyday use in different parts of the world and they impede foreign trade transactions because of their number and complication. In 1875, an International Conference on Weights and Measures fixed the standards of the International Metric System, and the International Bureau at Sèvres was afterwards established to preserve them. All scientific measurements are expressed in terms of the metric system, and in most countries the use of this system of weights and measures has been adopted. It was legalized in Great Britain in 1897, but was not made compulsory, though many Chambers of Commerce and other organizations have often urged its adoption, and the Decimal Association has persistently carried on a campaign in favour of it. Developments of mechanical engineering have, however, made a large general public familiar with a number of metric measures. Radio wave-lengths are expressed in metres, motor-car and aeroplane parts in millimetres or other subdivisions of the metre, and bores of guns and similar ordnance dimensions in the same decimalized units.

The metric system of weights and measures is truly the only system which can claim to be international in its scope and standards; and its use is likely to be extended after the present War. It does not matter much what standards or values are used for special trade or commercial transactions within customary regions or countries, but for business outside such areas, or with other peoples, fixed mercantile standards of an international kind are essential, and those of the metric system have been proved by adoption in most countries of the world to provide what is needed for international business.

In establishing the metric system on the Arabic scale of numerical notation and extending it to decimal fractions, French men of science at the close of the eighteenth century used the best methods of easy reckoning known in the history of mathematics. Their system also provided for a simple and uniform scale of relationships between the multiples and sub-multiples of the standard instead of the varying and unrelated quantities preserved in such tables as those of British weights and measures, upon which so much time has to be wasted in school and in everyday calculations.

By adopting the decimal scale of notation in the metric system the founders of the system used a natural plan of counting based upon the ten fingers of human hands and customary among more peoples than any other scale. A duodecimal scale has certain advantages over a decimal scale, as it permits simpler expression of halves, thirds and quarters, but it is futile to suggest the general adoption of a twelve or dozen scale either for national or international use. Whatever system of reckoning is used to express numbers and fractions, quantities will continue to be divided into halves, quarters and so on in everyday speech and practice, and new standards of weights and measures will be thought of in old denominations both locally and nationally.

As science is an international study, there must be common standards and units of measurement in all its branches in order to ensure uniform systems of comparison of results. After the discovery of radium and other radioactive elements, it became necessary to give quantitative values to their properties and to express them in agreed units. This was done by an International Radium Standards Commission, which adopted the quantity of radium emanation (radon) in equilibrium with one gram of radium as the standard unit and gave the name Curie to it. Units of physical science have thus entered the field of radioactive therapy.

One of the many useful services rendered by the Health Organization of the League of Nations has been the establishment and supply, on an international basis, of a series of 'standards of reference' by means of which the potency of many important specific agents used in medicine can be accurately determined and expressed in a commonly accepted system of notation. The series comprises standards for the assay of the antitoxins, the arsphenamines, the vitamins, insulin, the active principle of the posterior lobe of the pituitary body, many of the newly introduced sex hormones and the heart drugs.

Before the War, the international biological standards for the arsphenamines, vitamins, hormones and heart drugs were maintained at the National Institute for Medical Research, Hampstead, London,

and those for the antitoxins and tuberculin at the State Serum Institute, Copenhagen. After the occupation of Denmark, the League of Nations asked the Medical Research Council to undertake the supply of the standards for the antitoxins and tuberculin to those countries which had hitherto received these essential materials from Copenhagen. More recently, an international standard for vitamin E has been established and made available, and the work towards the establishment of a standard for the important anticoagulent, heparin, has been completed.

A World Language

Primitive man was able to represent objects and motions by drawings, and by doing so he used a sign language understood by all peoples. Sir Richard Paget, who has devoted much attention to this subject, has shown that the close relationship between the movements of the hand and mouth would associate the symbolizing of objects with sounds and gestures, and thus combine art and emotional expression in a sign language. The representation of objects is still preserved in the Chinese writing of a few characters, and in the infancy of the language two or more characters were combined to suggest a third thing or idea. The Chinese language was afterwards built up of characters representing sounds or phonograms instead of pictorial symbols or ideographs. An educated Chinese to-day will, however, draw ideographs to be read by a fellow countryman who speaks a different dialect.

Drawings provide a universal means of representing objects, and their characters also convey individual or composite emotions and meanings. Many early forms of writing are conventional characters developed from pictographs of this kind, and out of these conventionalized marks alphabets were constructed or characters were combined to represent syllables. All human beings express certain emotions, such as anger and fear, by much the same sounds, signs and gestures, and all can interpret simple picture writing, as all can understand the meaning of actions reproduced in moving pictures, silent or sound. There are, however, many conventionalized forms of characters to represent these sounds and thoughts by written or printed words, and these combinations make up the many languages of the world.

Among the important problems of an international kind to be promoted now and after the War is that of a means of expression in a language easily learnt and used by all civilized peoples of the world. The International Morse Code of signals is an example of an accepted system of alphabetical and numerical communication, and what is wanted now is an auxiliary vehicle of language which will be as widely understood. The subject of an international auxiliary language has long been under discussion, but we seem to be no nearer agreement as to what this language should be than we were after the War of 1914–18. In 1921, the British Association published a careful and comprehensive report on this subject, prepared by a committee representing humanistic as well as scientific interests, and in collaboration with the chief associations concerned with classical and modern languages as well as by consultation with a number of learned societies.

The British Association Committee was appointed after the International Research Council, at a meeting in Brussels in 1919, had taken up the question of an international auxiliary language and recommended the formation of an international committee to inquire into the position and outlook of the subject. It was hoped that a central international organization would be formed, under the League of Nations, and be empowered to make the final selection of the international auxiliary language, if feasible, and to take measures to ensure for it the greatest possible degree of stability. Chairmen were appointed to represent national committees for France, Italy, Japan and Belgium, and the chairman of the British Association Committee undertook to represent Great Britain on the Committee of the International Research Council.

The desirability of an international auxiliary language having been unanimously approved by the British Association Committee, attention was given to the advantages and disadvantages of the following three types: (1) a dead language, for example, Latin; (2) a national language, for example, English; (3) an invented or artificial language, for example, Esperanto or Ido.

The claims for the use of each of these languages as an international auxiliary language were justly and concisely stated by their own specialists in the report of the Committee. After careful consideration of this and other evidence from high authorities at home and abroad, the Committee found itself unable to pronounce judgment in favour of a particular auxiliary language for international use. The conclusions reached may be expressed as follows: (1) Latin is too difficult to serve as an international auxiliary language, and its advantages are outweighed by its disadvantages. (2) The great international languages of the past have all borne the marks of imperial prestige which prevented them from being welcomed by alien races. The adoption of any modern national language by the common consent of the chief nations is therefore unlikely, as it would confer undue advantages and excite jealousy, however impartial the promoters of the language might be. (3) Invented languages constructed on scientific principles and adaptable to many diverse requirements are practicable means of international communication. They are neutral and have advantages of simplicity not possessed by most national languages. What auxiliary language of this kind will meet with general approval remains to be decided by international agreement.

In the interest of international communication and the free expression of ideas, it is to be hoped that academic as well as scientific and commercial organizations will assist in the movement towards an agreed auxiliary language. A committee of the British Association on post-war university education has dealt with the subject recently in one of the sections of its report. It recommends that apart altogether from the academic study of language and literature, every university should require its students to be able to make themselves understood, by speech and writing, in an auxiliary international language. The Committee suggests that the Universities Bureau of the British Empire, in consultation with the American Universities Bureau and the Association of University Professors and Lecturers of Allied Countries in Great Britain, could take up the subject very appropriately and prepare a report upon it. There is no better way of promoting interrelationships between the peoples of the world than that of a simple common language; and the construction of such an instrument should not be beyond the powers of responsible authorities—literary, scientific and commercial—working together in a common and needful purpose.

THE MENDELÉEFF–BRAUNER TRADITION IN CZECH CHEMISTRY

By DR. GERALD DRUCE

EVER since the founding of the University of Prague in 1348, the Czechs have made their contributions to the advancement of science. In the Middle Ages, Prague and other Czech towns were centres for the practice of alchemy and a number of their pharmacies date back to these times.

Even during the dark days of the seventeenth century some Czech exiles, notably J. A. Komenský (Comenius), whose pansophism influenced some of the early members of the Royal Society, and the alchemist, Daniel Stolcius, maintained a high standard of knowledge and tried to lay the foundations for a wider and more general study of science when better days returned. Meanwhile, science was at a standstill in their homeland; no lectures or training were given until the end of the eighteenth century, when a scientific revival set in, and the biological sciences attracted most attention. Indeed, it was not until the time of Bohuslav Brauner (1855–1935) that Czech chemistry attained a world-wide significance.

Curiously enough, it was Brauner who did much to popularize the Periodic System postulated by D. I. Mendeléeff in 1869[1] and which might easily have received the ridicule accorded Newlands' Law of Octaves in 1863, though it was more likely to escape attention altogether on account of its appearing in an obscure Russian publication, especially as contemporary Western science was indifferent to so-called 'speculatory' articles.

The rapid verification of Mendeléeff's bold prediction of the existence of undiscovered elements, for which he left spaces in his Table, directed attention to his work, and it remained for Brauner and others to attempt to clear up the obscurities and anomalies. Thus, in order to establish his system, Mendeléeff had been obliged to alter certain accepted atomic weights (for example, that of beryllium) and to invert the order of others (for example, the pairs cobalt–nickel and tellurium–iodine). There were other problems such as that of the rare earths. To all these, Brauner gave his attention, as Mendeléeff frequently acknowledged[2], and there thus developed a cultural 'neo-Slavism' as distinct from the political 'Pan-Slavism' of last century. This found expression, too, in Brauner's advocacy of the Czech transcription for Russian names[3], Mendeléeff being rendered Mendělějev, a system that is more accurate but less acceptable in Great Britain on account of the diacritical marks involved.

In 1877, Brauner adduced evidence[4] that beryllium must have an atomic weight of 9, not 13·5 as previously supposed. This was confirmed by Nilson and Petterson, so that beryllium heads Group 2 of the Table, in accordance with Mendeléeff's arrangement. From his own investigations and by a critical study of those of Crookes and others, Brauner came to the conclusion that the rare earth elements, from lanthanum to lutecium, should be lumped together in the Periodic Table[5]. This work included his classical fractional separation of didymium into the three elements, neodymium, praseodymium and samarium. Brauner next devoted himself to the task of the exact determination of atomic weights, and his figures for a number of these (cerium, beryllium, praseodymium, tellurium, thorium and lanthanum) were accepted as the standard ones[6]. He was unable, however, to clear up the problem of the inverted order of tellurium and iodine, a question that was only solved after the discovery of atomic numbers.

In 1902, when the Periodic Classification was firmly established, Brauner again visited Mendeléeff, and his lecture at St. Petersburg (Leningrad) was one of the last meetings that Mendeléeff attended. In the following year the new Chemical Institute of the Charles University of Prague was opened, largely as a result of Brauner's efforts and through the international reputation he had by then acquired[7]. With better facilities at his disposal Brauner was able to educate a generation of Czech chemists before the War of 1914–18 brought liberation to his nation. A number of these continued in his researches on the rare earths, the most noteworthy being Prof. J. S. Štěrba-Böhm, who prepared and examined the lesser known compounds of cerium, scandium and germanium. Among the substances he prepared were a long list of double cerium oxalates[8] and many double salts of scandium, while his later researches on germanium[9], starting with a supply of argyrodite, brought the early work of Winkler up to date. His son, Dr. J. P. Štěrba-Böhm, was just beginning his career and had completed an interesting research on the sulphates, selenates and carbonates of scandium[10] when the Germans marched into Prague.

Brauner's atomic weight determinations were continued at his institute by Prof. H. Křepelka, who has shown equal skill and patience in estimations relating to arsenic, aluminium[11] and silver[12], Prof. O. Tomiček, who succeeded Prof. Štěrba-Böhm, had already specialized in improved methods of potentiometric analysis which were applied to the estimation of traces of elements as impurities and in evaluating the saline contents of thermal waters[13].

Probably the most outstanding contribution to chemical science made by Brauner's successors is the polarographic work of Heyrovsky[14] and his collaborators. This method, using the dropping mercury cathode, was first described in 1925, and though a steady stream of communications on the subject continued to appear, it was not until several years after that the full significance and importance of the method were appreciated. During the last few years it has found very wide application in many different directions. With the polarographic apparatus analyses can be carried out with so little as 2 c.c. of solution of 10^{-5} molar concentration and only requires that a known amount of the material under examination be brought into convenient solution, with perhaps the elimination of any interfering element. The automatically recorded polarogram constitutes a permanent record of the information obtained.

It was used, among other things, for the detection of Mendeléeff's dvi-manganese (rhenium) in crude manganese salts[15] and may thus be said to have assisted in filling one of the gaps in the Periodic Table, allowed for by Mendeléeff in 1869. Most of these gaps have now been filled, several during the period that Czechoslovakia was able to expand its scientific and research programmes. Thus, in 1922, hafnium was discovered[16] (or re-discovered), and Brauner put in a plea for the retention of Urbain's name, celtium, for this element[17]. Mention has been made of Czech contributions to the discovery of the congeners of manganese, now known as masurium

and rhenium. A third congener, which would have an atomic number of 93 and would thus be the next element beyond uranium, was announced by Koblic in 1935[18]. It was said to be present in certain residues from the working up of pitchblende for radium at Jáchymov (St. Joachimsthal), but as spectroscopic examination failed to reveal any new body, Koblic soon withdrew his claim to the discovery of bohemium, as he called the new element. In passing, it may be mentioned that in 1934 the hundredth gram of radium was extracted at Jáchymov, though by that time the Czech source of radium and pitchblende had lost its importance since far greater supplies are available in the Belgian Congo and near the Great Bear Lake in Canada. Nevertheless, Czech chemists and radiologists made valuable studies and applications of their supplies, particularly in medicine.

Brauner's life and work were influenced not only by his contacts with Mendeléeff but also by his connexions with Great Britain. His first interest in England began when as a boy he received a chemical set known as "Tutton's Chemical Box", which Prof. Frič took back to Prague from London. Later, in the 'eighties, he studied at Manchester under Roscoe and afterwards revisited England, taking the opportunity to read some papers before the Chemical Society[19]. It therefore became a part of his tradition that promising students were sent abroad to widen their outlook. Thus Štěrba-Böhm went to Paris to work under Moissan and Becquerel, Heyrovský came to London to hear Ramsay, Donnan and many other contemporary great chemists, Křepelka went to the United States to work under Richards. Between 1918 and 1938 a number of Czech students went abroad to spend at least a year of their academic life under Western influence. To-day it is only abroad that they are able to continue their researches and studies, for in the "protectorate" all universities and institutes are closed. When the nation is again liberated and the universities are opened once more, there is no doubt that the Mendeléeff-Brauner tradition of Czech chemistry will again inspire the nation's chemists to achieve results for the general advancement of science and the welfare of mankind.

[1] In March 1869, Mendeléeff circulated a memoir among members of the Russian Chemical Society. It set out his views on the periodicity of the elements and contained his first Periodic Table. The memoir was later reprinted in the Society's *Journal*.

[2] For example, in his "Principles of Chemistry".

[3] NATURE, **109**, 552 (1922).

[4] *Chem. Listy*, **2**, 30, 87, 129 (1877).

[5] *J. Chem. Soc.*, **41**, 68 (1882); *Ber.*, **11**, 872 (1878).

[6] *J. Chem. Soc.*, **67**, 549 (1895).

[7] *Rec. trav. chim.*, **44**, 281 (1925).

[8] *Collection Czech. Chem. Comm.*, **7**, 57 and 131 (1936).

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LANDSCAPE IMPRESSION AND THE EXTERNAL BASIS OF NATURAL BEAUTY

By L. C. W. BONACINA

IT is often said with some truth that this century has seen a welcome change from the last towards a desire to bring scientific knowledge and æsthetic appreciation of Nature more into line in human thought. Yet there were already signs of a change of outlook during the nineteenth century. That shrewd cosmopolitan thinker, Alexander von Humboldt, who helped to lay the foundations of so many of the geophysical and geographical sciences and saw so much of Nature in many lands, considered that it was not altogether possible to dissociate æsthetics from science in the study and contemplation of landscapes. As to Victorian England, it is instructive in this regard to note the respective attitudes of Tyndall and Geikie, for example, in science, and of Ruskin and Wordsworth in art and poetry.

Whatever may have been John Tyndall's theological views there can be no question that the whole outlook upon Nature of this celebrated physicist was consciously and deliberately artistic, and there are passages in his "Hours of Exercise in the Alps" which almost vie in descriptive power with Ruskin himself, leaving the reader with the conviction that to this great-hearted Irishman there was much more in the mountains than was comprised in their dimensions, form, structure and composition. Similarly, the eminent Scottish geologist, Sir Archibald Geikie, displays in his "Landscape in History and other Essays", which considers the human response to different types of country in Great Britain as also in Italy and Greece, highly imaginative insight into those imponderable but powerful environmental influences so vividly reflected in literature. Conversely, though the art critic, John Ruskin, may have given vent to irritable denunciations of scientific research, no one more loudly proclaimed the importance for creative work of careful and accurate, that is, scientific observation of natural phenomena, even going so far as to declare quite unjustly to Constable and others that no landscape painter before Turner had ever really looked at the clouds. In like manner, though William Wordsworth may have passed occasional rude remarks about geologists and astronomers, there is something in his very Nature-mysticism, unique among the great English poets, which is very reassuring from the wider philosophical and scientific point of view, and it is surely significant that a Wordsworthian text should have been selected as a motto for NATURE. Throughout Wordsworth we discern in the background tacit acceptance of scientific principle which makes for stability and enhances the value of much deep and passionate expression of feeling. There is a curious passage in the second book of "The Prelude" wherein the poet is thinking of the sun and moon both as cosmical bodies and as elements in the local landscape, and says of the latter, with respect to a beloved Cumbrian vale, that she hung

> "Midway between the hills, as if she knew
> No other region, but belonged to thee,
> Yea, appertained by a peculiar right
> To thee and thy grey huts, thou one dear Vale!"

This passage is valuable as seeming to illustrate a difficult, almost painful, spiritual attempt on the poet's part to co-ordinate and harmonize astronomical knowledge with artistic perception of the moon in relation solely to the local scene. It typifies that dual attitude of mind which every contemplative lover of Nature who is both man of science and poetical impressionist will find daily opportunities to exercise.

We are now in the twentieth century in sight of a more rapid convergence of the paths followed by the scientific investigator and the interpreter of natural beauty which, it is to be hoped, will eventually unite into one clear line of approach to truth about the external world. It is highly probable that the change is being accelerated in large measure by the fact that the various theoretical enigmas and paradoxes accruing to the great modern discoveries in physics and biology, together with the perplexing far-reaching implications of the doctrine of relativity, have taken us, metaphysically speaking, out of our depth, but in so doing have served to break down the hindering rigid distinction between 'subjective' and 'objective' fact which formerly appeared final. To-day the very meaning of traditional conceptions is becoming strained and challenged to such an extent as to force thinkers into the wholesome practice of putting in inverted commas all controversial terms which it seems to them either have not been, or cannot be, exactly defined.

Hence it seems fitting at the present time to reconsider the question whether the quality of beauty cannot be brought into closer scientific relationship with the grosser attributes of natural phenomena. If those who study Nature from the æsthetic side will help men of science by paying attention to accuracy of observation and to the subjection of their flights of imagination to scientific discipline, they will find themselves automatically in scientific company without loss of any power in their own proper sphere. Reciprocally, if men of science will respond to the overtures of artists and boldly confront the question whether natural beauty with all the ennobling emotions which it begets may not be something deeper and more systematized than a wayward subjective reaction to mere matter, they may soon discover fresh vistas opening out before them, so enlarging the scope of their own endeavours. It is indeed imperative in this complicated problem that scientist and artist should work together in order constantly to put questions to one another which neither would think of in isolation.

Landscape is not, of course, the only source of the experience of natural beauty, but since it comprises so much of human environment it affords a peculiarly convenient and effective one for the interchange of ideas as between science and æsthetics. For in the landscape the observer, whether scientific or artistic, becomes aware of a multitude of sense impressions from earth, water and sky for the descriptive differentiation of which language is quite inadequate. Words fail, for example, to denote the distinctive shades of 'green' which characterize the summer foliage of various species of trees even in identical illumination. In short, landscape observation brings both the seeker of physical facts and the lover of beauty up against the subtler truths of sense impression, and this in itself is a valuable corrective of the dangerous tendency of the human mind to think in categorical or class concepts in consequence of the limitations of speech. It is seldom suspected that a large amount of unnecessary controversy in many a field of thought arises out of the fact that the names we bestow on common objects, qualities and phenomena are in essence class-concepts concealing differences between members of the same group. This is why statistics involving broad categories are inherently dangerous and require much care in their interpretation. Contrariwise, it is the peculiar value of landscape impressionistic study that it leads to the intensive exercise of every sense-faculty, and thus invites the scientific observer and the artistic observer to walk together and exchange experiences derived from the concrete presentation of particular scenes. When the senses perceive so much more of reality than words can cope with, classes and categories, which are, after all, only mental attempts to arrange Nature's bewildering medley of overlapping, interlocking facts, are soon forgotten.

The question whether beauty is a quality residing in the object perceived or in the mind of the perceiver has long been at issue in philosophical circles, but this provides yet another example of the common fallacy of expecting a simple answer to an intricate question. It is very doubtful, indeed, whether the metaphysical distinction between beauty as a 'tertiary' attribute of matter, colour as a 'secondary' attribute and shape as a 'primary' attribute will bear searching logical analysis, for obviously beauty has certain objective or external foundations whatever purely subjective or personal elements may enter into its evaluation. The external physical basis of beautiful scenery consists in the association of a vast number of elements of form, colour, lighting, movement and the like, an association in which the human spirit discerns harmonious relationship. Now it is admitted that without sentient creatures all the wealth of landscape expressed in light, colour, sound and scent would vanish from the world even though the physical counterparts thereof as electromagnetic vibrations, air-waves and corpuscular emissions would remain. Similarly, though beauty as such might cease to exist upon the earth in the absence of man with his higher spiritual faculties, the physical counterpart thereof, namely, certain pictorial relationships of material elements, would be there just the same, for the external basis of a beautiful view does not depend on the presence of a spectator. It has been argued against the reality of any objectivity in natural beauty that people appreciate it so differently, some being largely blind and insensible thereto; but it might as well be argued against the reality of the grosser attributes of matter that some persons, through physical blindness or deafness, cannot see or hear them. Certainly in the exercise of a spiritual faculty like the æsthetic sense there should be scope for beauty to be variously interpreted, since different minds will tend to capture different aspects of the truth; but within such diversity there is a large measure of unity, particularly among persons of culture. When a common standard of reference for æsthetic values has been discovered, defined and agreed upon, the fallaciousness of this kind of argument will become apparent.

As the medium through which the scenic glory alike of the heavens and the earth is witnessed by the observer, the atmosphere plays a highly critical part, because every scene must be viewed through some sort of light and weather. In fact, the diversity of scenic moods exhibited by every landscape is evidently in response to a delicate balance of meteorological factors. The fact in itself opens out a promising field for joint investigation by artists and

meteorologists, as I have shown elsewhere in a series of essays on landscape meteorology. Readers of Thomas Hardy, who so skilfully portrayed his Wessex characters against what might be called the 'elemental' background of solitary heaths, woods and downs, may recall a passage in "The Return of the Native" wherein it is told that the great Dorset Heath could by its very expression anticipate the frowning of storms scarcely generated. This is more than a vivid local picture inasmuch as it typifies the mysterious manner in which the aspect of the country the world over responds to subtle unsuspected changes proceeding in the atmosphere, as though the slightest alteration in its physical condition as to light, temperature, moisture and other factors produced its counterpart in the æsthetic expressions of mountain, sea, forest, lake and the like. Theoretically it should be possible to relate the atmospheric states to the scenic expressions of the landscape, but in practice it might prove impossible to scrutinize the air with the closeness which a problem of such extreme intricacy would require. Nevertheless, the attempt would be well worth while if only it resulted in the formulation of a new vocabulary for the description of the 'scenic expression' in terms satisfactory to artists and men of science alike.

A suggestive fact in the problem of landscape beauty is the relationship between kindred features as members of a company. Just as a human personality needs to be drawn out by others, so does the scenic individuality of the trees, rocks and hills gain by interrelationship. We know how in a mountainous land the great peaks impart to one another a bearing which enhances the grandeur of the whole array, giving a new meaning to the music of torrent and cataract and the picture of gleaming glaciers. Similarly, along a high rugged coastline is it not the viewing of the multitude of rocky profiles in mutual relationship which gives the cliff scenery much of its inspiring character as we listen to the rhythmic impact of storm-waves or the low sinister murmur always uttered by the sea on such a coast in quiet weather? Sometimes, too, the very clouds gather in noble companies, as when gloriously lit in rifted storm masses—not the less suggestive because so transient. Then take the trees. Solitary trees admittedly can be superb, as a spreading oak or beech in field or park, a commanding ash on the skyline, a graceful birch at the entrance to a Highland glen, a shapely hawthorn in full blossom on the hillside, or a rowan tossing in wind and spray amid the boulders of a moorland stream; but it is nevertheless true that when trees of the same species grow in company with ample room for free individual development their beauty is intensified by pictorial interrelationship. Thus lofty elms often form groupings of the utmost elegance about English country lanes and village churches; but perhaps nothing in tree-beauty can exceed the magnificence at all seasons of the year of a fraternity of great oaks disposed or inclined towards one another in every comely posture, as commonly at the foot of a range of hills. In short, the universality of this kind of scenic companionability throughout the types of Nature furnishes a fundamental fact for contemplation and will demand much thought as the foundations of beauty are sounded.

The part played by animals in scenic beauty though, perhaps, less obtrusive than that by plants, is nevertheless of great importance in introducing two distinctive æsthetic elements, the one of living forms in motion against the physical background, and the other of mental reactions to the environment, both of which add much to our human sense of the geographical personality of different regions. This is a strong argument, apart from other reasons, for the strict preservation of what remains of the indigenous fauna of Britain or of any other country where the fauna is threatened. The song and notes of wild birds are so essentially part of the beauty of the landscape that it becomes a question to what extent our enjoyment of them, unlike that of the more elaborate musical compositions of man, really depends on this fact. Thus a divine melody of Chopin or Schubert need lose nothing from being heard in a city slum, but it is at least arguable whether the full emotional appeal of the trills and cadences of the nightingale is not inseparable from the sight or memory of such an associated setting as a flowery woodland dell or garden shrubbery in the month of May. Again, though the plaintive cry of lapwings may not be particularly beautiful in itself, it can become decidedly inspiring when these handsome plovers are seen with cattle and horses wheeling in a half stormy light over vividly green, high-perched meadows climbing up to moorland, as typically in Devon and other western counties.

Evaluation of the objective foundations of natural beauty is, of course, affected by various personal factors as, for example, knowledge, which is often a safeguard against spurious, illusory or incomplete impressions. Thus at least an elementary knowledge of the geological structure of a locality is essential to the full measure of appreciation of the beauty of the countryside. An artist would certainly miss the whole æsthetic scheme of the Wealden landscapes of Kent, Sussex and Surrey, for example, if he did not appreciate the difference of contour line and of vegetation characteristic of the great parallel ranges of chalk, greensand and Wealden sandstone similar in altitude and regional climate. Knowledge of history and purpose may be the means of awakening a person's susceptibility to the exquisite beauty of our Gothic cathedrals, just as, on the other hand, it has been said that visitors to the Great Pyramid have turned away in disgust on being told that it was built by sweated labour—insensible to its symmetrical perfection which is there all the same. Perhaps in the end they who find it difficult to divorce moral principles from physical attributes may be right.

Finally, we come to the question of the metaphysical meaning of the external basis of beauty. We have seen that it needs mind to translate these external qualities into the actual spiritual experience of beauty, but why should they be present in Nature to be so translated at all? Whence comes this mysterious expression of harmonious relationship between the component parts of what is called gross matter? It is a proposition difficult to dispute that the physical universe does actually possess the power to excite æsthetic emotions, and if this be really the fact it points strongly to the position of those philosophers who hold that the background of the universe is mental and the expression of intelligent Deity. Beauty is part of the manifestation of law and order throughout Nature, and its existence implies that the various elements comprising a landscape or other medium exhibiting beauty are related to one another in a manner capable of arousing spiritual pleasure in the beholder. Now if we admit that man's æsthetic faculty may have been evolved in response to some real counterpart existing in Nature in her own right,

we may find ourselves on the verge of new knowledge concerning the relation of the human soul to its physical environment; whereas, if we cling to what would seem to be the traditional view that the sense of beauty invests Nature with attributes she does not properly possess, being no more than a private personal subjective reaction to external influences, we shall never get the subject of beauty outside human psychology. The latter alternative spells sheer frustration, whereas the former at any rate looks promising. With this crucial issue the problem must be left for the present, but the article may appropriately be concluded with a quotation from the concluding chapter of the late Mr. J. W. N. Sullivan's "Bases of Modern Science": "The fact that a piece of matter has been reduced by relativity theory to a system of events, that it is no longer regarded as the enduring stuff of the world, makes the hypothesis that the 'physical' and the 'mental' are essentially similar very possible. . . . Our æsthetic and religious experiences need not lose the significance they appear to have merely because they are not taken into account in the scientific scheme. It is indeed possible that they will not always remain excluded from the scientific scheme." It is my growing belief that they will not and cannot remain so excluded.

ROLE OF HYALURONIDASE IN FERTILIZATION

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AQUEOUS extracts of mammalian testis contain a 'spreading' factor which dramatically increases the permeability of the skin to injected fluids. This factor is associated with the germinal epithelium and can be extracted from spermatozoa[1]. Factors with similar diffusing properties have been obtained from the most diverse sources, for example, from culture-filtrates and extracts of many species of invasive bacteria[2], from snake and spider venoms[3] and from leeches[4]. Chain and Duthie[5] reported a remarkable mucolytic activity of these extracts characterized by a rapid fall in the viscosity of synovial fluid and the liberation of reducing substances. This observation has been confirmed and extended by other workers and it appears that these spreading factors are closely associated if not identical with a group of enzymes that hydrolyse the hyaluronic acid of the synovial fluid, vitreous humour, umbilical cord and skin[6], and which are therefore known as hyaluronidases.

The role of the hyaluronidase of spermatozoa in fertilization has not hitherto been explained. Experiments designed to show whether this enzyme causes an increase in the permeability of echinoderm eggs comparable with that occurring immediately after fertilization yielded negative results[7]. Recent (unpublished) observations on the activity of the enzyme on bovine cervical mucin during œstrus and in the resting phase were also negative.

The presence of a transparent, viscous fluid or gel in which the cumulus cells and corona radiata surrounding the tubal egg of the rat are embedded was described by Long[8]. The removal of this substance and the consequent disintegration of the cell mass is necessary to enable the sperm to penetrate the egg. According to Pincus and Enzmann[9] the dispersal is brought about by a heat-labile substance produced by the spermatozoa. Earlier work by Yamane[10] showed that a preparation of pancreas removes the cells surrounding the egg of the rabbit, an observation which was confirmed by Pincus and Enzmann[11], who used purified trypsin. They observed, however, that in addition to removing the cells, partial digestion of the egg occurred, and so it is highly improbable that the process of denudation of the egg in the Fallopian tube is effected by trypsin or a similar proteolytic enzyme. The facts recorded above suggested that hyaluronidase might be responsible for the phenomenon, and the following experiments were carried out.

Ovulation was produced in immature rats and the eggs removed from the Fallopian tube as previously described[12]. The action on the gel and cell masses of hyaluronidase obtained from various sources (see table below) was investigated. In addition, the supernatant fluid of a centrifuged suspension in Baker's solution[13] of rat sperms killed by heating at 50° C. for five minutes and a similar preparation of rabbit semen were tested, together with the secretions of the seminal vesicles (vesicular fluid) and prostate of adult rats. The action of some detergents such as sodium glycocholate was also recorded. The action of all these substances was observed in the following manner: 0·2 ml. of saline (0·8 per cent sodium chloride) was pipetted on to a watch-glass and an equal volume of enzyme dilution added and mixed. A cluster of 6–12 eggs was then immersed in the mixture and the rate of dispersion of the cells

THE ACTION OF HYALURONIDASE AND OTHER SUBSTANCES AND PREPARATIONS ON THE DISPERSION OF THE CUMULUS CELLS OF THE RAT OVUM.

Substance tested	Hyaluronidase		Time taken to disperse cumulus cells and corona radiata (min.)
	v.r.u./ml.	m.c.p. test	
Bovine testis hyaluronidase	0·6		165
	0·85		142
	6·0		36
	8·5		33
	15·0		20
	15·0		20
	30·0		17
	60·0		11
	85·0		9
Streptococcal hyaluronidase	0·6		100
	6·0		32
Cl. welchii hyaluronidase	5–7·5		27
	10–15		19
Vibrion septique hyaluronidase	2·5		30
Rattlesnake venom 0·5%*		+	17
0·05%		+	27
Rat sperm extract*		+	12
	3·25		22
Rabbit semen extract*		+	18
Rat and guinea-pig vesicular fluid		—	No effect in 2 hr.
Rat prostatic fluid		—	" 78 "
Taka diastase, 0·5 %		—	No effect in 3 hr.
Diastase, 0·5%		—	
Sodium glycocholate 0·5 %		—	" "
Baker's solution		—	" "
Physiological salt solution		—	" "

* Ten minutes heating at 100° C. destroyed activity as shown both by m.c.p. test and inability in a period of 3 hours to disperse the cells surrounding the egg.

though, perhaps, less obtrusive than that by plants, is nevertheless of great importance in introducing two distinctive æsthetic elements, the one of living faculty may have been evolved in response to some real counterpart existing in Nature in her own right.

observed under a binocular dissecting microscope. The action of hyaluronidase would appear to be solely one of liquefaction of the gel, which causes the cells to fall away from the ovum and collect on the bottom of the watch-glass. The end-point of the reaction was taken to be the complete denudation of the egg. Accurate timing of this point is difficult because a few cells may adhere to the eggs after the reaction is apparently complete. These cells, however, can be displaced quite easily by slight agitation of the watch-glass. The cells and the egg appeared to be unaffected by the enzyme.

The hyaluronidase titre of various samples of enzyme is recorded in viscosity-reducing-units (v.r.u.) or by their capacity to prevent the appearance of a typical mucin clot on the addition of acetic acid to a substrate consisting of albumin and hyaluronic acid (m.c.p. test).

The table shows that the rate at which the cumulus cells were dispersed is closely correlated with the concentration of hyaluronidase, obtained not only from spermatozoa and testis but also from *Streptococcus, Cl. welchii* and *Vibrion septique*. The activity of the enzyme derived from bacteria and from snake venom, and the close correlation with the activity of testicular hyaluronidase, is additional evidence that this is a specific effect of the enzyme, since it is unlikely that preparations from such diverse sources would all be contaminated with some other active agent.

Cell masses exposed to the action of detergents such as sodium glycocholate become almost invisible but the gel is not liquified. The impaired optical definition of the cells might be due to lowering of surface tension of the cell boundaries. Of interest is the fact that even after careful and prolonged washing of these cell masses, the action of hyaluronidase is afterwards inhibited. Further work is being carried out in this connexion.

The absence of any action of vesicular and prostatic secretions on the gel is additional proof that the hyaluronidase content of semen is of testicular origin. Moreover, the evidence recorded above, although entirely circumstantial, suggests that the gel surrounding the eggs in the Fallopian tubes contains hyaluronic acid.

The production of such enormous numbers of sperm for the fertilization of the mammalian ovum and the fact that the reduction in the sperm count rapidly leads to sterility has always aroused interest. It is clear that the intromission of a large number of spermatozoa is required to ensure that even a single one shall enter the egg. If a large number are required in the immediate vicinity of the egg, then their purpose may well be the production of a concentration of hyaluronidase sufficient to liquify the hyaluronic acid gel and so allow penetration of the egg by the single effective sperm. The possibility should be borne in mind that a deficiency of the enzyme may cause certain types of sterility for which there has been, hitherto, no obvious explanation, and investigations on the hyaluronidase content of semen in infertility are contemplated.

We are indebted to Dr. C. Rimington for many helpful suggestions and advice, and to Dr. H. King, who supplied the rattlesnake venom.

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NEWS and VIEWS

Newton Tercentenary Meetings

IT is inevitable that, as the human race grows older, jubilees and centenaries should multiply—indeed, unless due discrimination be shown, there may be a weariness in their multiplication. But, if ever there was a single outstanding name in the history of scientific achievement, that name is Isaac Newton's, and, in the noble words of his lapidary inscription in Westminster Abbey, men of science the world over will rejoice that such and so great a glory of the human race has been permitted to dwell among us for a season. The story of Newton's surpassing achievements in dynamics and optics, of his fashioning of the mathematical tools necessary to his adventures, of his excursions into theology and chemistry is a long and involved one. Myth and legend have grown around Newton's almost superhuman figure—and yet he was human enough in many aspects. No doubt many of these myths can be dispelled by the light of modern scrutiny, but in telling the tale of his immortal work, we shall be the better able to assess the greatness of Newton's influence on his contemporaries and successors.

Newton was born on Christmas Day, 1642, and the Royal Society is marking the tercentenary year by devoting its anniversary meeting on November 30 to commemorative lectures. These will be delivered during the afternoon in the lecture theatre of the Royal Institution. Prof. E. N. da C. Andrade is speaking on "Newton and the Science of his Age" at 3 p.m.; and after a brief interval, at 4 p.m., Lord Rayleigh will lecture, with experiments, on "Newton as an Experimenter" and Sir James Jeans on "Newton and the Science of Today". It is also hoped to arrange a small exhibition of Newton manuscripts, instruments and other relics. The Physical Society has also arranged a commemorative lecture, which will be delivered by Prof. Andrade in the lecture theatre of the Science Museum, London, on December 4 at 4.30 p.m. and in the Cavendish Laboratory on December 9 at 2.30 p.m.

Josef Bohumir Mikan (1742–1814)

J. B. MIKAN, a pioneer in the revival of the study of science in Bohemia, was born two hundred years ago, on December 4, 1742, at Česká Lípa in North

The presence of a transparent, viscous fluid or gel

cells surrounding the egg.

Bohemia. He studied medicine at Prague under Count William Macneven, whose Irish forbears accompanied James II to the Continent in 1689 and became landowners in Bohemia. Count William was director of medical studies in the University of Prague and took a prominent part in supporting the incipient Czech cultural revival during the era of 'enlightened absolutism' under Joseph II. Through Macneven, Mikan, who had become a practitioner at the spa of Teplice, was appointed professor of botany and chemistry at the university in 1775. This post he held for thirty-seven years, lecturing and carrying out research. He re-established proper courses of instruction and made it obligatory for students to qualify in both chemistry and botany as well as in their other subjects. In order to secure proficiency Mikan established the first chemical laboratory in Prague in 1784 and also laid out a botanic garden that is still in existence. The laboratory was a primitive affair adapted from a store-house of the original Carolinum, but it enabled him and his assistants to undertake the first analyses of many Czech spa and thermal waters.

After 1792 'enlightened absolutism' gave place to the 'reactionary absolutism' that lasted until 1848 and under which science was not encouraged. Not until 1810 were more commodious laboratories put at Mikan's disposal, and such progress as he was able to make was achieved in the face of much opposition, although a few progressive nobles gave him and his students encouragement and financial aid. Mikan was thrice dean of the medical faculty (there was no science faculty until much later) and was for many years vice-director of studies. When he retired in 1811 two appointments were made. His son, Jan Kristian Mikan, who had previously acted as his assistant, became professor of botany, and J. Freysmuth was appointed lecturer in chemistry. At this time there were no contemporary scientific publications in Czech, so that Mikan's writings are all in German and his name is usually rendered J. Gottfried Mikan. His work was, nevertheless, of vital importance for the advancement of science among the Czech nation.

Finance and Social Service in Great Britain

THE recent Political and Economic Planning (P E P) broadsheet "Fair Shares for All" (No. 192) is a fitting counterpart to that issued earlier in the year under the title "Financial Mysticism" (No. 188). The latter made a useful contribution to lucid thinking about five simple questions: the financing of the War; the risk of national bankruptcy; the value of 'warship weeks'; export policy; and the repayment of the National Debt. In regard to the first of these questions, the point is driven home that the real cost of the War is the sweat and sacrifice it imposes, part of which is borne by the present and part by the future. In regard to bankruptcy, the false analogy between State and individual spending is exposed, while the true object of 'warship weeks' of helping us to get warships without inflation is clearly indicated. Similarly, the importance of subordinating trade policies, when peace returns, to the over-riding aim of winning the peace, is demonstrated as well as the necessity of regarding the national resources as a sum of man-hours instead of a sum of pounds sterling, and of the imperative need for avoiding waste of men and material either by unemployment or the misdirection of resources.

In the later broadsheet, a realistic analysis is given of civilian consumption and the war effort, which suggests concisely the directions in which taxation and rationing might be further extended to promote first the war effort, but simultaneously lay the foundations for social reconstruction after the War, by giving priority to the poorest groups of the population as part of a national consumption policy to wipe out malnutrition. A much more determined attack on the 'vicious spiral' from the under-consumption end is required. The essential problem here is that of subsidizing consumption among families with several children, and accordingly family endowment is now the chief weapon which must be used to combat under-consumption, though the problems of prisoners, the sick, the families of men in the Forces, and of workers receiving unusually low wages, must be considered. Much more needs to be done in respect of school-feeding services and tax relief for children before the existing services providing family endowment benefits can be regarded as adequate. Further development of the subsidized food schemes, a definite family allowance scheme, co-ordinated with existing services and for occupations where earnings are very low, and wage increases to a reasonable minimum are other proposals designed to secure a comprehensive policy and develop the maximum war effort.

Illusions about the Size of the Moon

PROF. E. G. BORING and his associates at the Harvard Psychological Laboratory have quite recently undertaken precise measurements to determine how large the moon appears, both on the horizon and near the zenith (*Sky and Telescope*, Sept.). Various observers compared the moon with an artificial moon placed at a standard distance, and the size of the artificial moon could be varied to agree with the real moon. An arrangement was made to control the orientation of the observer's head, so that the angle between direct vision and the elevation of the moon could be measured. The artificial moon, placed at a distance of 12 ft., appeared from 2° to 6° in diameter to people with normal vision and using both eyes. The experiments were conducted to choose between four modern theories which are associated with the physiology of the eye. The old theory that the moon is contrasted with terrestrial objects when near the horizon is ruled out by the fact that this illusion disappears when we view the horizon moon with the head upside down. The theory that the celestial sphere looks flattened overhead, the apparent distance of the moon thus varying, is also eliminated. Ames's theory alone out of the four modern theories is not finally rejected. When the eyes are raised, it has been found that the right eye tends to rotate clockwise, as viewed from the back, with respect to the left eye, and this fact may explain the moon illusion for binocular vision. It is admitted, however, that the results are not conclusive.

Technical Basis of Sound Reproduction

AT the November meeting of the British Institution of Radio Engineers, held at the lecture hall of the Institution of Structural Engineers on November 21, Dr. L. E. C. Hughes read a paper on "The Technical Basis of Sound Reproduction". His treatment of the subject was based on his experiences as technical adviser to the Central Council for School Broadcasting, and was general in character. Dr.

Hughes described the various degrading effects on sounds by the chamber in which they are emitted or reproduced. The final test is always a subjective one, and owing to the short memory of the ear it is necessary for comparisons between the original performance and the reproduction to be direct. This is difficult, and the method Dr. Hughes advocated was to use two separate chambers with a microphone in each to represent the listener, and to compare their outputs subjectively at the remote end of a very good quality amplifier.

Dr. Hughes explained that each letter has its own requirements in the matter of frequency range for good reproduction of speech, but he stressed the point that the final test is always an aural one in the tests conducted by the Apparatus Approval Committee of the Central Council for School Broadcasting, where non-technical audiences vote subjectively on the quality of reproduction on a scale attained entirely by experience. In the discussion which followed, doubts were expressed as to the validity of subjective tests, but Dr. Hughes stated that a completely new panel had, in duplicate tests, returned votes which were within 1–2 per cent in agreement with the regular panel.

Michelia Timbers for Aircraft

A SERIES of leaflets has recently been issued from the Forest Research Institute, Dehra Dun, on utilization matters. No. 17 deals with the species of Michelia of which the *champaca* (champ) is the most important, being fairly common in Assam and cultivated all over India for its fragrant flowers. Its true habitat is in the Eastern Himalaya, Sikkim and Assam. There are four other species of the genus in India, but they are less abundant. The timber of the five species is very similar in weight and strength and is only slightly heavier than spruce (being about 33 lb. per cubic foot as against 30 lb. for spruce) and compares very favourably with spruce in strength.

Michelia timber seasons without difficulty or degradation; it is straight grained and very easy to work both by hand and machine tools. It can, it is said, be finished to a beautiful smooth surface and is a pliant wood to handle; also it can be peeled on a rotary lathe and sliced on a slicing machine to produce excellent veneers for plywood. It is not surprising, therefore, that this timber should prove very suitable as a substitute for Sitka spruce in the manufacture of aircraft. It is stated that though supplies are limited, if the wood of these species is reserved for aircraft construction in India alone, available supplies would go some way to supplying the needs of the industry. This takes one back to a century ago when the same remarks were being made in Malabar and Tenasserim in connexion with the teak demands of the Bombay Dockyard and the Admiralty in Great Britain.

Indian Woods for Battery Separators

LEAFLET No. 14 of the Utilisation Section, Forest Research Institute, Dehra Dun, deals with investigations into woods for battery separators. The battery separator is a thin sheet made of wood, ebonite or glass interposed between the positive and negative plates of an acid storage battery in order to prevent the plates from touching each other during handling or use, while at the same time allowing the ionic exchange to take place in the electrolyte. When wood is used its essential characteristics must be good permeability, freedom from volatile acids, low percentage of tannins and resinous matter, sufficient mechanical strength and resistance to chemical action of the electrolyte. The most commonly used timber has been the American *Chamæcyparis lawsoniana* or the Port Orford cedar. The Indian Forest Research Institute has been investigating the suitability of Indian timber for the purpose for some time past. The research work has shown that the following are suitable for use as battery separators: *Adina cordifolia* (*haldu*), *Cupressus torulosa* (cypress), *Michelia champaca* (champ or champak), and *Talauma phellocarpa*. The leaflet describes some of the tests carried out. As regards the Michelia it is more likely to be earmarked for aeroplane construction than battery separators, unless the wastage from the former can be utilized for the latter.

Horticultural Science

SEVERAL papers upon scientific aspects of gardening have appeared in recent numbers of the *Journal of the Royal Horticultural Society* (vol. 67). Dr. B. A. Keen expounds his doubts of the value of hoeing except for the destruction of weeds (Part 10; Oct. 1942). This conception must now express the ideas of many workers who have considered the mechanism of water movement in soil. The experiments quoted are upon an agricultural scale, but should also have direct reference to horticulture. M. Mather publishes further work upon the effect of the moon on germination and seedling growth (Part 8; Aug. 1942). He again finds no consistent lunar influence, but can explain all the differences recorded for tomato and maize by the effects of temperature and light. The moon is not known to exert a great influence upon these two factors. Other experiments on growth of tomatoes are those of Dr. M. A. H. Tincker (Part 8), who finds that extracts of the vitamins in yeast do not improve growth or enhance the vitamin B_1 content of the plant.

Air Vice-Marshal A. E. Borton records (Part 10) satisfactory control of the Rhododendron bug *Stephanitis rhododendri* by spraying with an atomized pyrethrum wash. 'Die-back' disease of apricots makes cultivation of this crop difficult in Great Britain. H. Denham and H. Wormald show (Part 8) that the trouble is caused by the brown rot fungus *Monilia cinerea* (*Sclerotinia laxa*). It can be controlled by the removal of shoots with wilted flowers or leaves, or dead twigs. Spraying with copper carbonate washes is also mentioned.

Rubber Economy in Typewriter Cylinders

ACCORDING to an article by A. R. Kemp (*Bell Lab. Rec.*, **20**, No. 12; August 1942) savings in the rubber used for typewriter cylinders are now possible as a result of experiments recently carried on in the Bell System Chemical Laboratories. These cylinders consist of an arbor of steel or wood over which is slipped a sleeve of rubber. The rubber is vulcanized on the arbor, and then ground to the proper size and to roughen its surface so as to grip the paper firmly. With extensive use, the cylinders become hard and glazed, and no longer hold the paper securely. They have then been returned to the factory to have the old rubber removed and new rubber put in its place. It has been estimated that

from fifty to one hundred thousand cylinders need to be renewed each month.

Tests have shown that by sand-blasting the glazed cylinders for two or three minutes, using No. 90 steel grit and an air pressure of 15–20 lb., a surface was formed that in many ways was superior to the original. The reduction in cylinder diameter due to this resurfacing is less than 0·002 in. Cylinders treated in this manner have had hard service in Bell Laboratories for more than six months without showing need for further treatment. Cylinders that have been ground have a grooved structure, while sand-blasted cylinders have an irregular pattern of minute projections that grips the paper firmly in all directions. The sand-blasting, moreover, knocks out the fine particles of filler compound that otherwise would reduce the friction between paper and cylinder, much as talcum powder would. Typewriter cylinders vary considerably in size, but on the ordinary letter-page machine the rubber weighs about 1 lb., and with more than a million replacements a year, sand-blasting promises a considerable saving of rubber compound.

Cancer Mortality

THE June issue of the *Statistical Bulletin*, the organ of the Metropolitan Life Insurance Company of New York, contains an editorial based on a series of observations extending over a number of decades, from which the following conclusions emerge. While the recorded mortality among males from all forms of cancer has shown an increase by about one third in the course of thirty years, the rate among females has changed but little. Towards the end of the period there has been some improvement among females, while there has been a slackening in the upward trend for males. The result has been that the rates for males and females at ages 1–74 which widely differed in 1911–15 have converged to a common level of 86·8 per 100,000 in the quinquennium 1936–40. A substantial cause of the rise in cancer mortality among males is probably due to improved diagnosis—a supposition confirmed by a consideration of the mortality from cancer of the various organs. Since 1911 mortality of cancer of the peritoneum, intestines and rectum has practically doubled in the case of males and increased by about 50 per cent in females. The mortality from cancer of the pancreas and prostate has also risen sharply. The rise in the death-rate from cancer of the lung and pleura has been attributed to improvement in diagnostic technique. The most hopeful outlook occurs in the case of those organs which are readily accessible such as the female genital organs, the skin and mouth, in each of which the mortality has declined since 1911. Cancer of the breast is exceptional in that, in spite of its accessibility, its mortality has increased during the thirty years. The improvement due to early recognition and treatment of suspected growths is illustrated by the fact that the American College of Surgeons has records of more than 36,000 cases of so-called "cured" cancer.

Health of the United States Army

ACCORDING to the War Department, the army training in the United States is in better health than ever during war-time. It is anticipated that the general hospital admission rate in 1942 will be about 10 per cent lower than in 1941. Venereal disease is substantially less than during the War of 1914–18, the syphilis rate being the lowest in army history. The total venereal diseases rate was 40·5 per 1,000 men in 1941 and 38 per 1,000 during the first six months of 1942. Throughout 1941 and thus far in 1942, the death-rate has been the lowest in army history. During this period, from one half to two thirds of the deaths resulted from external causes such as traffic accidents. The meningitis fatality rate in the army is far below that in civil life. The malaria rate per 1,000 men in the Continental United States was only 0·61 for the first eight months of 1942 as compared with 1·24 in 1941. Universal vaccination has virtually eliminated smallpox, and rigid sanitary control and inoculation have rendered typhoid almost non-existent. The incidence of scarlet fever is now extremely low.

Public Health in Brazil

THE September issue of the *Boletín de la Oficina Sanitaria Panamericana* contains an article by Dr. João de Barros Barreto, director-general of the National Department of Health, Rio de Janeiro, who states that this department has the following sections: administrative service; divisions of public health and hospital organization; Oswaldo Cruz institute for the study of prevalent diseases and the manufacture of sera, vaccines and chaulmoogra esters; national services for leprosy, tuberculosis, yellow fever, malaria, plague, mental diseases, control of medicine, port sanitation, water and sewerage, and vital statistics, and since September 23, 1942, the national service for cancer. Courses in public health are given by the National Health Department and include microbiology, immunology and parasitology, vital statistics, physiology, urban and rural sanitation, epidemiology and prophylaxis, industrial, child and mental hygiene, nutrition and public health organization and administration. A number of scholarships are granted to medical men through the Panamerican Sanitary Office.

Fevers in the Sudan

THE recently published report, for 1940, of the Director of Medical Services of the Sudan, contains an account of an epidemic of yellow fever which broke out in that country in July and continued until the end of 1940. The number of known cases was 15,633, of which 1,627 were fatal. The real incidence was probably greater as many of the cases were mild and atypical, and therefore were not notified. The epidemic was particularly remarkable in that, so far as was known, yellow fever had never occurred previously in the Sudan or indeed in any part of the Old World east of the centre of Africa. The report also contains an account of a long-continued epidemic of relapsing fever which started in 1936 and reached its peak in 1940 with 1,487 cases. It is a remarkable fact that though relapsing fever is louse-spread, no mention is made in this report or any of its predecessors of typhus, so that this disease seems to be absent from the Sudan.

Books on Historical Medicine and Science

THE firm of Schuman's, 20 East 70th Street, New York, has recently issued a catalogue "Medical Miscellany List 'F' ", containing a number of interesting books and periodicals of which the following may be

mentioned: Sir Benjamin Brodie's "Physiological Researches" (1851), Edwin Chadwick's "Report on the Sanitary Condition of the Labouring Population of Great Britain" (1843), A. Weismann's "Vorträge über Deszendenztheorie" (1904), first edition of Gray's "Anatomy" (1858), William Hamilton's "Observations on the Preparation, Utility and Administration of Digitalis Purpurea or Foxglove" (1807), Francis Home's "Medical Facts and Experiments" (1759), Hufeland's "Art of Prolonging Life" (1797), Lord Lister's "Contributions to Physiology and Pathology" (1859), Thomas Bateman's "Reports on the Diseases of London, and the State of the Weather from 1804 to 1816" (1819), Puschmann's "Handbuch der Geschichte der Medizin" (1902–1905), the first two volumes of *Archiv für Physiologie* (1796–97) and a number of runs of the *Lancet* from 1848 until 1871.

Recent Earthquakes

DURING the third quarter of 1942, the epicentres of ten strong earthquakes have been found chiefly from instrumental data from American observatories. The first four epicentres in July and August were determined at St. Louis by the Jesuit Seismological Association, and the others in August and September by the United States Coast and Geodetic Survey, in co-operation with the Jesuit Seismological Association and Science Service. On July 8 the epicentre was in Chile (24·5° S., 69·5° W.) with a depth of focus near 175 km. A later earthquake on July 8 and one on July 12 had their epicentres near the coast of Ecuador (0·3° S., 80·2° W.) and a depth of focus near 500 km. The latter was reported felt at Guayaquil. On August 6 the earthquake had its epicentre in the Pacific Ocean off the coast of Central America (12·9° N., 92·1° W.). On August 23 a shock had its epicentre in the Pacific Ocean between the Kamchatka Peninsula and the Aleutian Islands (51·5° N., 163° E.). Further shocks in the same region were on September 2 (52·5° N., 170° W.), September 4 (52·8° N., 169·2° W.), and September 9 (53·1° N., 165° W.). Sequences of shocks in this manner are not uncommon and the present group is somewhat to the west of a similar group some months ago. The shock of August 24 had its epicentre near the coast of Peru (14·5° S., 75·5° W.) with a depth of focus between 50 km. and 100 km. A further earthquake with its epicentre in the Pacific Ocean off Central America (12·5° N., 91° W.) occurred on September 4. On Thursday, October 29, an earthquake was felt in Western Turkey, including Istanbul and Smyrna. No damage has been reported.

A New Comet

A COMET was discovered by Oterma on Sept. 11d. 23h. Its position at the time of discovery was R.A., 23h. 51m., Dec. + 6° 20′, and its magnitude was 13. A later telegram announces that the comet was observed again on Nov. 6d. 20h. 16m., and its position then was R.A., 4h. 11m., Dec. − 0° 47′. Its magnitude had not altered. It was stated to be moving slowly northward. An orbit will be computed when a third position is obtained.

The Night Sky in December

NEW moon occurs on December 8d. 01h. 59m. U.T., and full moon on December 22d. 15h. 03m. Conjunctions during the month are as follows: Dec. 6d. 13h., Mars in conjunction with the moon, Mars 5° S.; Dec. 20d. 17h., Saturn in conjunction with the moon, Saturn 3° N.; Dec. 24d. 13h., Jupiter in conjunction with the moon, Jupiter 3° N. Occultations of stars brighter than magnitude 6 are as follows, the times referring to Greenwich:

d.	h.	m.		
Dec. 12	19	15·0	μ Capricorni	*D*
15	22	13·4	14 Ceti	*D*
20	19	32·7	α Tauri	*D*
	20	44·5	α Tauri	*R*
26	03	06·2	σ^2 Cancri	*R*
		34·0	σ^1 Cancri	*R*
27	23	32·9	45 Leonis	*R*
28	02	50·2	ρ Leonis	*R*

Mercury, Venus and Mars are not well placed for observation during the month. Jupiter, in Gemini, souths at 2h. 10m. about the middle of the month and is well placed for observation. Saturn, in Taurus, souths at 22h. 50m. in the middle of the month and can be observed all night. The Geminid meteor shower is active during December 7–15, the radiant being close to α Geminorum. The winter solstice commences Dec. 22d. 12h.

Announcements

THE Minister of Supply has appointed Prof. J. E. Lennard-Jones, Plummer professor of theoretical chemistry in the University of Cambridge, to be chief superintendent of armament research, and Mr. F. E. Smith, of Imperial Chemical Industries, Ltd., to be chief engineer and superintendent of armament design. These appointments have resulted from the recommendations of a committee under the chairmanship of Dr. H. L. Guy recently appointed by the Minister of Supply to review the machinery for the conduct of research, design, and experimental work in connexion with the development of guns, small arms, and ammunition.

DR. C. D. DARLINGTON, director of the John Innes Horticultural Institution, has been invited to deliver lectures to the Mendelian Society of Lund in Sweden. He will journey to Sweden under the auspices of the British Council, and, in addition to his lectures at Lund, will speak on cytology to learned societies in other centres, and will also deliver a number of general lectures on a broad biological topic.

THE Earl of Moray and Mr. J. M. Bannerman have been appointed members of the Forestry Commission in succession to Sir John Sutherland, who has submitted his resignation, and to fill another existing vacancy. At the request of the Secretary of State for Scotland, Sir John Sutherland has agreed to continue to attend meetings of the Commission so that his experience may be available when matters relating to Scotland are discussed.

THE council of the Royal Meteorological Society has awarded the Buchan Prize for 1943 to Dr. T. E. W. Schumann and Mr. Gordon Manley. The Prize is awarded biennially to the authors of the papers published in recent issues of the Society's *Quarterly Journal* which have been adjudged to contain the most important original contributions to meteorology.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. No notice is taken of anonymous communications.

Connexion between the Penetrating Non-ionizing Component of Cosmic Radiation and Penetrating Showers

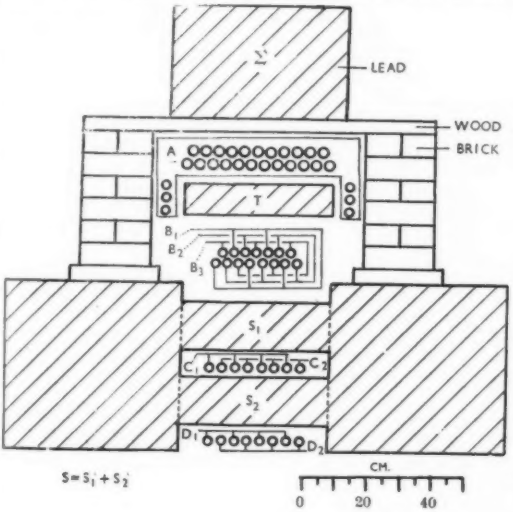
IN a recent publication[1] we suggested that there is a connexion between penetrating showers produced at sea-level and the penetrating non-ionizing radiation discovered by Rossi and Regener[2] on Mt. Evans and by us at sea-level. The present investigation was undertaken with the object of establishing such a connexion. The results show that a considerable fraction of the penetrating showers are produced by a penetrating non-ionizing radiation, but that only a small fraction of this radiation produces penetrating showers.

The experimental arrangement, illustrated diagrammatically herewith, was a combination of the arrangement by which penetrating showers were originally observed[3] and the arrangement used to observe the non-ionizing radiation[1].

Sevenfold coincidences $B_1-B_2-B_3-C_1-C_2-D_1-D_2$ involving counters out of each of the three trays, B, C and D, were recorded; one of us has shown for a similar arrangement[3] that such coincidences are mainly due to penetrating showers.

If the absorbers T and Σ were removed, only penetrating showers coming from the air were recorded. On placing an absorber T above the counter tray B, the coincidence rate increased by $0{\cdot}289 \pm 0{\cdot}062$ coincidences per hour, the increase being due to the showers produced in T. To show that a considerable fraction of these showers were due to non-ionizing agents the following method was used.

The absorber T was covered on five sides by a set of anti-coincidence counters consisting of thirty-five counters in parallel. Thus a non-ionizing particle producing a penetrating shower in T could give rise to an anti-coincidence, that is, a sevenfold coincidence not accompanied by the discharge of any



Absorbers		Time	Coincidences		Anti-coincidences	
T (cm. Pb)	Σ (cm. Pb)	hr.	Total No.	Rate per hr.	Total No.	Rate per hr.*
0	0	306 : 15	162	$0{\cdot}529 \pm 0{\cdot}042$	5	$0{\cdot}023 \pm 0{\cdot}010$
10	0	380 : 30	311	$0{\cdot}818 \pm 0{\cdot}046$	24	$0{\cdot}086 \pm 0{\cdot}018$
10	5	1289 : 56	1100	$0{\cdot}853 \pm 0{\cdot}026$	59	$0{\cdot}063 \pm 0{\cdot}008$
10	35	1344 : 20	924	$0{\cdot}688 \pm 0{\cdot}023$	33	$0{\cdot}033 \pm 0{\cdot}006$

* Corrected for random coincidences.

of the counters A. With $T = 10$ cm. of lead, $0{\cdot}086 \pm 0{\cdot}018$ anti-coincidences per hour were recorded. All these anti-coincidences might have been due to non-ionizing particles, but to show that at least part were, in fact, due to non-ionizing rays and not to some spurious effect, observations were carried out with a variable absorber Σ placed above the anti-coincidence set. It was expected that some of the non-ionizing particles moving towards T would be absorbed in Σ. Thus the decrease of the rate of anti-coincidences with increasing thickness of Σ was a measure of the rate of anti-coincidences due to non-ionizing particles.

It is clear from the data given in the accompanying table that the anti-coincidence rate falls considerably as Σ is increased from 0 to 35 cm. of lead. We conclude, therefore, that some of the showers produced in T are produced by non-ionizing particles.

The non-ionizing radiation does not seem to consist of photons, as photons would be almost entirely absorbed in 5 cm. lead, while our observations show a marked absorption as Σ is increased from 5 cm. to 35 cm. of lead. It is not unreasonable to assume that this radiation is part of the penetrating non-ionizing radiation reported previously[1,2].

As the range of the non-ionizing radiation cannot be determined accurately from our data, it is difficult to estimate its rate of incidence. Rough calculations, which will be given elsewhere, indicate (1) that the rate of incidence is about 1 per cent of the rate of non-ionizing radiation observed with our previous arrangement[1], and (2) that one third of the penetrating showers produced near sea-level are produced by the penetrating non-ionizing radiation.

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G. D. ROCHESTER.

[1] Jánossy, L., and Rochester, G. D., NATURE, **148**, 531 (1941); and *Proc. Roy. Soc.*, A, in the Press.
[2] Rossi, B., and Regener, V. H., *Phys. Rev.*, **58**, 837 (1940).
[3] Jánossy, L., *Proc. Roy. Soc.*, A, **179**, 361 (1942).

Purification and Chemistry of Penicillin

THE lability of penicillin is such as to preclude most of the ordinary chemical manipulations. Attempts by us to purify the material by the procedure of E. P. Abraham and E. Chain[1] had little success, perhaps for reasons which appear below. After a lengthy search, we have developed a new chromatographic technique involving a chemical reaction which for the first time provides a rapid means of concentrating penicillin to a high degree with the minimum risk of chemical change.

Penicillin is chromatographed from an organic solvent such as ether or amyl acetate on a column consisting of a water-retentive support such as silica-gel

or 'Hyflo-Supercel' which is associated with an inorganic base such as a hydroxide or carbonate of an alkali or alkaline earth metal. The base is applied either in the form of a dilute solution in water, or as a mechanical mixture, or preferably precipitated on the carrier before use; a suitable column consists of a 2·5 per cent precipitate of an alkaline earth carbonate on silica-gel. Doubtless the process is a combination of 'chemical' chromatography and 'partition' chromatography, the constituents of the crude penicillin being separated primarily according to the strengths of the component acids; whereas in the adsorption column, differences in adsorption affinity are magnified by a large number of elutions and adsorptions, in the present process differences in acid strength are magnified by repeated neutralization and acidification. The process is of general applicability, and we have found it can conveniently be used to separate alkaloids on silica-gel retaining a solution of sodium hydrogen sulphate.

The above process leads to theoretical recovery of penicillin and easily affords manifold concentration. Most of the work referred to below was carried out on material (strontium salt) containing *ca.* 500 units/mgm.[2]. We have on occasion obtained material containing 750 units/mgm.

Penicillin obtained by us in the form of its strontium salt after drying *in vacuo* at 60° or 100° gives analytical figures in agreement with the formula $C_{24}H_{34}O_{11}NSr$; electrometric titration gives an equivalent of 249, the smooth curve showing only a single inflexion, from which it would appear that the two acid groups are not adjacent. The salt is yellow and possesses an absorption band at 265 mμ ($E^{1\%}_{1cm.}$ *ca.* 390) which is unaffected by treating with aluminium amalgam; it appears to have no measurable optical activity.

Very mild inactivation is accompanied by fission of the molecule. We have used dilute acid, alkali, or moist organic bases such as aniline, methylaniline, dimethylaniline or *p*-nitraniline for this purpose (fission with ammonia is more complicated and leads for the first time to fluorescent materials). The isolated products are (*a*) a substantially colourless water-soluble acid, (*b*) varying quantities of a yellow almost insoluble pigment, and (*c*) acetaldehyde which is accompanied by a minute quantity of an αβ unsaturated aldehyde, $C_7H_{12}O$, the significance of which is questionable; no carbon dioxide is liberated. The water-soluble acid affords ether-soluble and ether-insoluble acids on further hydrolysis, of which the second gives a positive ninhydrin reaction; it thus appears to be a simple peptide. The pigment, $C_{16}H_{20}O_6$ or perhaps $C_{16}H_{18}O_5.H_2O$, shows two characteristic colour reactions which we have found reliable indications of the localization of penicillin on the column: the first is a transient cherry-red colour with strong nitric acid, and the second a permanent deep red colour with a dilute solution of sulphuric acid in glacial acetic acid. The pigment possesses absorption bands at 261 and 397 mμ ($E^{1\%}_{1cm.}$ 290 and 305) but does not appear to be a quinone; although it titrates as a monobasic acid it is more probably enolic in character (a tetronic acid ?). Whenever penicillin is treated with aluminium amalgam it ceases to give the above colour reactions and an insoluble hydrolysis product, now colourless, gives analytical data corresponding to $C_{16}H_{20}O_6$, indicating that this treatment results in reduction. Ozonolysis of the pigment provides acetaldehyde together with other products as yet unidentified, while degradation with alkaline permanganate gives at least three molecules of oxalic acid.

We thank the Therapeutic Research Corporation of Great Britain, Ltd., under whose auspices this work is being done, for permission to make this preliminary statement.

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Nov. 13.

[1] *Brit. J. Exp. Path.*, **23**, 103 (1942).
[2] Florey *et al.*, *Lancet*, **241**, 177 (1941).

Notatin: an Anti-bacterial Glucose-aerodehydrogenase from *Penicillium notatum* Westling

IT has been shown[1] that when a selected strain of *Penicillium notatum* Westling is grown on a Czapek-Dox medium an anti-bacterial substance is produced which differs in the majority of its properties from penicillin[2,3,4]. This anti-bacterial substance was originally named 'Penicillin A', but in order to avoid confusion with penicillin we now prefer the name 'notatin'. This substance is isolated by concentrating the culture filtrate to approximately one fifth of its volume under mild conditions and precipitating the concentrate with acetone or by producing a complex with tannic acid from which notatin is regenerated by extracting the tannic acid with acetone[5]. The crude substance can be purified further by regeneration from the complexes which it forms with tannic acid and with Reinecke salt. The average yield of purified notatin is 3–4 gm. from 100 litres of culture filtrate.

Notatin is a buff-coloured powder freely soluble in water, but almost insoluble in organic solvents. The aqueous solution has *p*H 6–7 and the activity is rapidly destroyed at *p*H's below 2 or above 8 or by heating to 60° C. Notatin is decomposed by 70 per cent aqueous methyl alcohol at 30° C. and by aqueous trichloracetic acid, yielding a precipitate of protein and a solution containing the prosthetic group, both of which, tested singly, have no anti-bacterial action. A typical sample of notatin afforded the following figures on analysis: C, 50·0; H, 6·7; N, 11·8; P, 0·58 per cent, the results being corrected for moisture (11·1 per cent) and ash (5·3 per cent). Specimens containing less than 1·4 per cent ash have been prepared. Some preparations contain a small quantity of catalase, but only traces are present in others.

Notatin affords positive reactions in many protein tests and it also responds to the luminoflavin test. The absorption spectrum in aqueous solution exhibits maxima at 280, 375 and 465 mμ, which characterize it as a 'yellow enzyme'. The extinction coefficient of the absorption band at 465 mμ runs parallel with the anti-bacterial activity. The other properties of the substance are also those of a flavoprotein and by assuming the molecular weight 73,000, which is that of the majority of flavoprotein enzymes, it can be calculated from the extinction coefficient of the absorption band at 465 mμ that the purity of our best preparations is about 90 per cent. A purified solution of the non-protein part of the molecule was prepared by treating a solution of notatin with trichloracetic acid and applying Warburg and Christian's method[6]; the absorption spectrum of this

solution was closely similar to that of riboflavin. The silver salt of the prosthetic group is insoluble, and notatin is therefore probably a dinucleotide.

Notatin only exerts its anti-bacterial activity under certain well-defined conditions, but under these conditions it is a very powerful bactericide. The conditions are:

(1) presence of oxygen;
(2) presence of glucose;
(3) absence of appreciable amounts of catalase.

Our best preparations completely inhibit the growth of *Staphylococcus aureus* in dilutions as great as 1 part in 1,000,000,000. They are also active in very high dilutions against other Gram-positive and Gram-negative organisms including *Strep. hæmolyticus*, *Strep. pneumoniæ*, *Bact. typhosum*, *Bact. paratyphosum A* and *B*, *Bact. typhi-murium*, *V. choleræ*, *Bact. anthracis* and *Proteus vulgaris*.

It has been found that in the presence of notatin, glucose is converted by oxygen to gluconic acid with simultaneous production of hydrogen peroxide. Quantitative experiments indicate that the oxidation may be represented by the equation

$$R.CHO + H_2O + O_2 \rightarrow R.COOH + H_2O_2,$$

although there is a deficiency of hydrogen peroxide when notatin is contaminated with catalase. The whole behaviour of notatin is thus consistent with the view that it is an enzyme similar to, but much more potent than, the glucose oxidase obtained by Müller[7] from *Aspergillus niger* mycelium and further examined by Franke and his collaborators[8], who consider it better described as a glucose aerodehydrogenase.

In vivo experiments are in progress and will be reported at a later date; there is evidence of a therapeutic effect with exceedingly minute doses of notatin.

In a recent publication[9] Kocholaty mentions "penatin", a newly discovered anti-bacterial substance produced by *Penicillium notatum* Westling, which differs from penicillin. The chemical and bacteriological results given in his communication are insufficient to show whether penatin is identical with notatin.

The work described above was carried out under the ægis of the Therapeutic Research Corporation of Great Britain Ltd. A more detailed account of the investigation will be published in due course.

C. E. COULTHARD. R. MICHAELIS.
W. F. SHORT. G. SYKES.
Boots Pure Drug Co., Ltd.
G. E. H. SKRIMSHIRE. A. F. B. STANDFAST.
The British Drug Houses Ltd.
J. H. BIRKINSHAW. H. RAISTRICK.
London School of Hygiene and Tropical Medicine.
Nov. 14.

[1] British Patent Application No. 13242 of October 14, 1941: Boots Pure Drug Co., Ltd., C. E. Coulthard, R. Michaelis and W. F. Short.
[2] Fleming, *Brit. J. Exp. Path.*, **10**, 226 (1929).
[3] Clutterbuck, Lovell and Raistrick, *Biochem. J.*, **26**, 1907 (1932).
[4] Chain, Florey, Gardner, Heatley, Jennings, Orr-Ewing and Sanders, *Lancet*, **239**, 226 (1940). Abraham, Chain, Fletcher, Florey, Heatley and Jennings, *ibid.*, **241**, 177 (1941). Abraham, Chain and Holiday, *Brit. J. Exp. Path.*, **23**, 103 (1942). Florey and Jennings, *ibid.*, **23**, 120 (1942).
[5] British Patent Application No. 8189 of June 15, 1942: The British Drug Houses, Ltd., and G. E. H. Skrimshire.
[6] *Biochem. Z.*, **298**, 150 (1938).
[7] *Biochem. Z.*, **199**, 136 (1928); **205**, 111 (1929). *Ergebnisse der Enzymforschung*, **5**, 259 (1936).
[8] *Annalen*, **532**, 1 (1937); **541**, 117 (1939).
[9] *J. Bact.*, **44**, 142 (1942).

Transformation of Benzpyrene in the Living Skin of Mice into a Compound Soluble in Dilute Alkali

THE skin of white mice painted with benzpyrene fluoresces violet at first, but within two to four days the colour of the fluorescence changes slowly to blue. The blue persists for two to three weeks, until it cannot be distinguished from the natural bluish-white fluorescence of the skin[1]. The spectrum of the violet fluorescence contains the typical groups at 427 and 455 mμ of molecularly dispersed benzpyrene. The blue spectrum contains two diffused bands at about 450 and 425 mμ. It is similar to, but apparently not identical with, the fluorescence spectra of 'BPX'[2,3] and the orthorhombic crystalline modification of pure benzpyrene[4]. It is, however, different from the fluorescence spectrum of the monohydroxybenzpyrene which Chalmers and Crowfoot[5] have isolated from the fæces of rats injected with benzpyrene. We have also observed this blue fluorescence in the kidney cortex, liver and lung of mice and rabbits, and in the protein fraction of the milk of lactating mice after injection of benzpyrene[1].

In a new set of experiments the skins of white mice were painted with benzpyrene in acetone and the mice were killed after various periods from ¼ hr. to eight days. The skins were then removed, dried and extracted with cold benzene to remove the loosely attached benzpyrene. Fluorescence spectrography of the transparent skins mounted in xylol between slides showed the 'blue' bands from about six hours after painting. They increased in strength until the fourth day and then faded slowly. The dry skins of 1- to 4-day mice were treated overnight with (*a*) 0·01 *N* caustic soda and (*b*) 0·01 *N* hydrochloric acid.

(*a*) The alkaline extract fluoresced blue, while the extracted skin retained some of its fluorescence; after acidifying, the blue fluorescence could be extracted with ether and re-transferred to the aqueous phase by adding fresh alkali.

(*b*) The acid did not show any fluorescence due to benzpyrene, but on extracting the acid-wet skins with ether, blue fluorescence (with weak violet bands deriving from traces of unextracted molecular benzpyrene) entered the ether. The blue fluorescence could be transferred to the aqueous phase with 0·01 *N* caustic soda, and re-transferred into ether after acidifying.

It must be concluded that the blue fluorescence is due to a benzpyrene derivative which is soluble in alkali. It is produced in the painted skins, and persists over periods of several weeks.

We established by low-power microscopy in ultra-violet light that a strong blue fluorescence followed exactly the rows of the hair bulbs. This indicates that the compound is confined to the quickly proliferating cells of the Malpighian layer. It may therefore be of greater importance for the production of tumours than the original benzpyrene itself, especially because this blue-fluorescent compound persists in the skin long after the parent hydrocarbon has disappeared.

Mount Vernon Hospital, Northwood, Middlesex. J. C. MOTTRAM. F. WEIGERT.
Nov. 11.

[1] Weigert, F. Brief reports in *Chem. and Ind.*, p. 641 (1941) and *Brit. Emp. Cancer Campaign Report*, p. 90 (1941); full account in the Press.
[2] Peacock, P. R., *Brit. J. Exp. Path.*, **17**, 164 (1936).
[3] Chalmers, F. G., *Biochem. J.*, **32**, 271 (1938).
[4] Weigert, F., and Mottram, J. C., NATURE, **145**, 895 (1940).
[5] Chalmers, F. G., and Crowfoot, Dorothy, *Biochem. J.*, **35**, 1270 (1941).

Condition of Freshly Burnt Gases

IN his interesting article[1] on "The Condition of Freshly Burnt Gases", Dr. A. G. Gaydon gives very clear expression to his view that during the combustion of dry carbon monoxide mixtures the freshly formed carbon dioxide is charged with a large excess of vibratory energy which is only very slowly partitioned; but if the carbon monoxide mixtures are moist, or a little hydrogen is added to them, partitioning of the excess vibratory energy in the carbon dioxide takes place rapidly because of the powerful deactivating influence of water vapour. Experiment, however, seems to indicate that this view is untenable.

It has been found that the *rate* of emission of infrared radiation measured after (even immediately after) the combustion of reasonably dry carbon monoxide–air mixtures is not greater than that measured after the combustion of similar mixtures in which a little of the carbon monoxide is replaced by hydrogen[2]. Indeed it is rather less, because water vapour radiates more powerfully than carbon dioxide. At all times after combustion, the *rate* of emission of radiation from carbon dioxide, like that from water vapour, would appear to be dominated by flame gas temperature (mean molecular translational energy) and influenced not at all by its previous combustion history.

The question as to whether or not normal gases would luminesce if externally heated to the temperatures usually attained in flames and explosions is one of long standing, and Dr. Gaydon redirects attention to it in his article. He suggests that gases like nitrogen, oxygen and carbon monoxide would not luminesce, and probably there will be general agreement with this view. He thinks, however, that carbon dioxide would luminesce after the fashion of carbon monoxide flame gases on account of the recombination which is continuously taking place after dissociation.

But there is, I think, much evidence for the contrary view, and some of this has been referred to by me in a previous communication[3]. Even more convincing evidence seems to be provided by the flame photographs of carbon monoxide – oxygen explosions taken by Bone and Frazer[4]. The photographs show that when these mixtures are ignited by means of an ordinary spark, the usual luminosity is displayed by the resulting flame gases (for example, photograph No. 19). When, however, they are ignited by means of a very powerful spark, a considerable volume of the gases formed under its influence is dark (for example, photographs Nos. 22 and 23), and this in spite of the fact that an enormous amount of dissociation and recombination must be taking place in them, for their temperature is of the order of 3,000° C.

It is not without interest to observe that the long-tube explosion photographs of Bone and Frazer[5] suggest that flame gases also tend to approach the condition of normal hot gases just immediately after detonation has been set up (see, for example, photographs Nos. 5, 17, 22 and 32).

While Dr. Gaydon's article makes it clear that explanations differ, it is becoming increasingly recognized that the experimental evidence for the existence of a long-lived latent energy in carbon monoxide flame gases is irrefutable. The experimental evidence that it exists in hydrogen and hydrocarbon flame gases is, I think, equally irrefutable[6].

W. T. DAVID.

Engineering Department,
The University,
Leeds.
Nov. 2.

[1] NATURE, **150**, 481 (1942).
[2] *Phil. Mag.*, **15**, 177 (1933), Figs. 2 and 4.
[3] NATURE, **150**, 291 (1942).
[4] *Phil. Trans. Roy. Soc.*, **228**, 197 (1929).
[5] *Phil. Trans. Roy. Soc.*, **230**, 363 (1931).
[6] NATURE, **150**, 521 (1942), and *Phil. Mag.*, **22**, 513 (1936).

PROF. DAVID refers to his experiments with Parkinson on the rate of emission of radiation from explosions. In this paper I find no mention of any drying process for the gases, or of any attempt to remove adsorbed moisture from the explosion vessel. I therefore assume that the gases were far from dry, and these experiments can scarcely be compared with those of Garner and colleagues to which I referred. They appear to me to support my statement that the concept of vibrationally activated molecules could not explain afterburning or latent energy of long duration in hydrogen-rich fuels. Also I may perhaps be permitted to quote Prof. David's own words relating to some earlier work on coal-gas–air explosions[1], that the "rate of emission of radiation is a maximum about 1/40 sec. before the attainment of maximum temperature". This effect is also very well shown in the curves of David and Parkinson to which Prof. David refers, Curve A in Fig. 2 showing a difference of about 0·03 sec. and Curve B in Fig. 3 of more than 0·05 sec., although for mixtures rich in hydrogen the effect is not observed.

I have shown[2] that the radiative life of the asymmetrical vibration for carbon dioxide is of the order 0·01 sec. and that even in absolutely dry gases the time for equipartition of vibrational energy will be, at most, a few tenths of a second, and very considerably less in the presence of moisture. It is doubtful whether a bolometer of 0·02 sec. period (as used by David and Parkinson) would be adequate for work on moist gases.

With regard to the luminosity of hot gases, I still retain an open mind. I have made it clear in my article and book that the radiation from a carbon monoxide flame is mainly due to chemical causes, and the failure to record appreciable light from hot gases in the neighbourhood of a powerful spark using a very short exposure time proves nothing, except that there is less chemical action taking place. This is probably the result of the pressure wave reducing the time-lag in the equipartition of vibrational energy, and thereby the amount of abnormal dissociation.

I do not feel qualified to express an opinion as to the existence of long-lived latent energy in hydrogen and hydrocarbon fuels. I have already pointed out that there is much apparently contradictory experimental evidence.

A. G. GAYDON.

Imperial College of Science
and Technology,
London, S.W.7.

[1] *Phil. Trans. Roy. Soc.*, A, **211**, 375 (1911).
[2] "Spectroscopy and Combustion Theory", p. 121. (London: Chapman and Hall, 1942.)

ASSOCIATION OF SPECIAL LIBRARIES AND INFORMATION BUREAUX

SEVENTEENTH ANNUAL CONFERENCE

THE sixteenth annual conference of ASLIB (Association of Special Libraries and Information Bureaux) was planned to be held at University College, Nottingham, in mid-September 1939, but had to be cancelled owing to the outbreak of hostilities; the papers which were prepared for that Conference were afterwards published. The previous Conference had been held at Oxford in 1938 during the Munich crisis. Any idea of holding a succeeding conference in 1940 was rudely shattered by the Battle of Britain, but the comparative lull in the autumn of 1941 encouraged ASLIB to embark on the project of resuming its annual conference in 1942, with the limitation that the principal meeting should be held in London, and the papers there read and discussed should be available for subsequent local meetings in various provincial centres.

The decision to hold the London Conference proved to be very happy, and the generosity of the Royal Society in providing accommodation for the meetings and other functions greatly contributed to the successful outcome. In all, 137 members of ASLIB and visitors attended the several sessions, which occupied the afternoon and evening of November 7 and the morning and afternoon of November 8, and were preceded on the morning of November 7 by the annual general meeting of the Association.

At this meeting, Prof. R. S. Hutton, Goldsmiths professor of metallurgy, Cambridge, was elected president for the ensuing year, in succession to Sir Harry Lindsay, who had served since November 1939. Mr. Theodore Besterman was elected honorary secretary in succession to Mr. Edward Carter, and Mr. E. Lancaster-Jones was re-elected honorary treasurer. At a later meeting of the council, Messrs. Carter and Lancaster-Jones were re-elected respectively chairman and vice-chairman of the council.

The Conference opened at noon on Saturday with a characteristically stimulating address on international systems and standards given by Sir Richard Gregory. The main part of Sir Richard's address is printed elsewhere in this issue (p. 620).

At the first session of the Conference proper, under the chairmanship of Prof. A. C. Egerton, two papers dealing with training in the use of libraries were presented by Mr. C. H. C. Osborne, honorary secretary of the School Libraries Section of the Library Association, and Prof. R. S. Hutton respectively. The former dealt with school and the latter with university libraries, and each indicated the extent to which instruction in the methodology of libraries might be imparted, with mutual benefit to the library and its user. Comparisons of conditions in Great Britain with the practice in other countries, especially in the United States, was deprecated by some speakers in the subsequent discussion, on the grounds that conditions were not comparable. Nevertheless, the feeling was general that more could be done by librarians and educational authorities to educate those who would ultimately have to depend largely upon reference literature in the technique of extracting it from the vast resources of modern libraries.

At the second session, on the evening of November 7, Dr. Luxmore Newcombe, of the National Central Library, took the chair and the audience listened with avidity to Mr. Besterman's demand for a "Union List of Periodicals in British Libraries". In his customary blend of dogmatic confidence that difficulties were merely so many bubbles to be pricked and experienced skill in deflecting the anticipated missiles of more substantial composition, Mr. Besterman carried his hearers into a calm and purposeful realm of accomplished fact. One had the distinct impression that the Union Catalogue was as good as in one's hands, and some of us who have experienced the tenacity with which its proponent pursues an objective on which he has set his mind had the uneasy conviction that in due course we should be involved in the usual mass of collation attendant upon the production of all Union Catalogues.

Nevertheless, we shall be willing victims, for all of us realize that these monumental contrivances are essential to the ultimate objective of planned economy and efficiency in our national resources of vital reference periodicals. The two editions of the "World List of Scientific Periodicals" have done a great deal in the period intervening between the two World Wars to enable Great Britain to build up its resources, particularly of the more obscure foreign scientific and technical periodicals. Much remains to be done, but all previous Union Catalogues and lists have largely ignored the wealth of reference material that now exists in the various special libraries.

A paper on "Agriculture and the War Stimulus" by Mr. C. S. Orwin, director of the Agricultural Economics Research Institute, had to be taken as read in the absence of its author or any suitable substitute for him.

At the third session, on the morning of November 8, Colonel E. E. B. Mackintosh, director and secretary of the Science Museum, took the chair for a symposium on microfilms, which attracted a very appreciative audience. Mrs. Lucia Moholy, director of the Aslib Microfilm Service, sketched the early uses of microphotography for communication of information in war-time and proceeded to describe the evolution and functions of the Aslib Microfilm Service in the present emergency. To a considerable extent the Service is occupied in photographing on microfilm current issues of foreign scientific and technical periodicals that emanate from enemy or enemy-controlled countries and are received in very small quantities in Great Britain. The microfilms are used to provide additional copies of the whole issues or excerpts therefrom, as required by individuals or institutions having no access to the originals, or desiring their own copies. The necessity for the provision of reading apparatus to enlarge the microfilms to legible dimensions was stressed, as the supply at present available in Great Britain is wholly inadequate.

Mrs. Moholy's interesting paper was followed by one by Mr. E. Lancaster-Jones, keeper of the Science Library, in which the attributes of the microfilm copy of a normal reference book or volume of a periodical, as compared with the original, received detailed consideration. The possibilities of supplementing the microfilm copy by various guides in order to adapt it to facile use by the staff and clients of a reference library were sketched. A further paper by Dr. Vernon Tate, of the National Archives, Washington, D.C., had been promised for this symposium, but was unavoidably delayed in transit. As Dr. Tate's experience of microfilm technique is profound, this was a great disappointment.

In the subsequent discussion on the two papers, many helpful remarks were made upon the provision of reading apparatus by the adaptation of available mechanisms, such as cinema projectors, to the purpose, and there is no doubt that those individuals who possess the skill and equipment to carry out the minor constructional modifications needed can produce a reasonably efficient machine for enlarging the films, certainly for the purposes of individual research. But one has only to handle an efficient commercial reader, specially designed for the work, to realize that its construction is the result of long experience of the problem, and the results are very satisfying. A small exhibition of reading apparatus, arranged by the Aslib Microfilm Service, proved very popular and instructive.

The final session of the Conference, under the chairmanship of Mr. T. R. Dawson, of the Research Association of British Rubber Manufacturers, was devoted to a paper by Mr. J. E. Wright of the Post Office Research Station on "Some Methods used in the Special Library of a Research Department", followed by one on "War-time Books and Periodicals: some Suggestions", by Mr. B. M. Headicar. Mr. Wright's paper was not merely an account of the methodology of the particular library of the Post Office Research Station, but also contained a rich fund of information and suggestions adapted to use by any similar library; a series of clues to specific requests for information was perhaps the most interesting and instructive section of the paper. Mr. Headicar dealt in his customary adept manner with a multiplicity of practical details, including suggestions for economy in paper and binding; he illustrated his address by greatly appreciated practical demonstrations of the methods recommended.

SEASONING OF TIMBER

By ALEXANDER L. HOWARD

Necessitas non habet legem ("Piers Plowman", 1377).

WHILE it is true that the harsh dictates of necessity have resulted in many discoveries and useful practices in the seasoning of timber, laws regarding the process are adamant; and although simple, the principles which govern the procedure are unalterable. The sap and moisture contents must be drawn out of the wood and the necessary methods employed to bring the wood to that degree of moisture content desired. The process must be varied according to the species of timber and the purpose for which it is required.

Never in the history of Great Britain has this question been of such vital importance as it is to-day. Commodities of all sorts—food, delicate instruments, ammunition, and war material of all kinds—must be packed safely for transport over great distances and under trying conditions, and it is essential that the cases used for this purpose can be relied upon to preserve their valuable contents.

Of those materials which can be used, timber plays the most important part. We are forced to rely to a very great extent upon available native timber, which could be put to better use if adequate facilities for seasoning existed.

It has been proved that timber of many kinds, and in the dimensions required, can be seasoned in a satisfactory manner in a short time, and indeed there are already many established kilns fully occupied and successfully working, but in no sense sufficient for the demands of total war. Even though it involves great expense and effort, many more drying kilns of efficient design should be established as quickly as possible to make good this deficiency.

Fortunately, the lessons of the War of 1914–18 and scientific research have enabled us to overcome all the main difficulties, and the chief problem that concerns us is no longer the method to be employed, but the establishment of sufficient kilns throughout the country.

The primary object is to create within the kiln a continuous and regular current of air (at first charged with moisture) to suit the condition of the unseasoned or fractious wood, and then to withdraw the moisture and introduce the heat by carefully controlled degrees, until the desired percentage of moisture contents has been acquired. To accomplish this, it is essential that every square inch of the timber should be subjected to an equal volume of the current, and while the dimensions of the kiln play an important part, by far the greater importance lies in the scientific application of the correct combination of moisture and heat.

During the course of the last hundred years, innumerable processes have been tried out, many of which have been patented but later abandoned. Among these systems is a process which might be described as a 'bakery'—that is, one in which the timber is placed in a compartment somewhat similar to an oven. Other ingenious systems have been tried, in which the wood is subjected to a vacuum, with water and steam introduced later. Another process has been to place the timber in boiling water accompanied by the introduction of saccharine or other ingredient, and a still further attempt has been made by the use of an electric current. Most of these, or perhaps all, have been abandoned, at least so far as commercial practice is concerned: at another time, and in more easy circumstances, it would be desirable to enter into further scientific research, which might give us more information and thus secure even better results. At present our endeavour should be to concentrate our attention towards providing that which we know can secure an immediate as well as a satisfactory result.

Two methods are available, which are what are known as the 'progressive' and the 'compartment' kilns, both well understood and universally accepted.

For large quantities of box boards the progressive method would probably be efficient, but this system would not succeed when applied to the more fractious and difficult woods, when the compartment system should be adopted.

In the progressive kiln the wood is placed on trucks, allowing sufficient air space between the boards. The trucks are moved under control through successive chambers which have been prepared with the necessary saturation of moisture and the introduction of dry heat. The moisture contents are gradually withdrawn and the dry heat increased. On completion, the charge is found to contain that correct percentage of moisture contents which was calculated as ordered.

In the compartment system, as the name implies, the timber is piled with similar air ventilation, but in a fixed chamber where moisture and heat are introduced. As in the case of the progressive kiln, the moisture is gradually withdrawn and the heat

increased, so that after the necessary period, which varies according to the description and thickness of wood, whether fractious or kindly, the chamber may be opened and the charge will be found to conform to any given degree of moisture contents stipulated. Complete reliance can be placed on either of these methods.

The outlay required to provide an adequate number of such kilns throughout Great Britain will, of course, be heavy, but having regard to the urgency, this consideration ought to be of secondary importance.

An ample supply of properly seasoned timber for the boxing and safe transport of the vital necessities of war is essential to our war effort, and until this question has been adequately dealt with we may suffer serious losses, not only financial but also endangering the health and welfare of our troops and those of our Allies.

NEW AND LITTLE-KNOWN FISHES

THE *Stanford Ichthyological Bulletin*, published by the Natural History Museum of Stanford University, is responsible for many valuable descriptions of fishes, and the two numbers before us (2, No. 4, Aug. 24, No. 5, Aug. 31, 1942) contain various papers, the most striking of which are George G. Myers's "Studies of South American Freshwater Fishes" and Albert W. C. T. Herre's "New and Little Known Phallostethids, with Keys to the Genera and Philippine Species". The Natural History Museum of Stanford University has amassed a large collection of South American fishes, which, together with the very extensive South American material in the California Academy of Science, forms probably the finest series available anywhere for the study of South American fluviatile ichthyology.

In the present work are included fishes from Amazonian Peru, from Venezuela and from Rio de Janeiro. Especially interesting is *Hoplomyzon atrizona* n.g. et sp., a new Bunocephalid from Peru, which is armed with a series of bony plates along the body, and apparently has no close relatives. It is adapted for life in swift water and the head has maxillary barbels strongly resembling some of the hill-stream Nematognaths.

Many new Cyprinodonts were collected by Lieut.-Col. and Mrs. White in the coastal plain of the State of Rio de Janeiro, their object being to study them in their own aquaria. Fishes of the genus Cynolebias are favourites with aquarists and are known to be annual fishes with a full life-cycle within one year. They are usually found in isolated water holes, swamps and ponds which dry up in the dry season, only the eggs surviving in the mud. After hatching in the wet season, development of the fry is rapid and in some instances full growth is attained in two or three months. The species of this genus, owing to their specialized habitat and seasonal occurrence, are seldom seen by ordinary ichthyologists and are usually only obtained through commercial aquarium fish collectors. The present series is therefore specially valuable. It includes many new forms of these very beautiful small fishes which in life are brilliantly coloured. Five of the new species are described and notes given from colour sketches made from the living material.

Herre's paper on the Phallostethids describes many of these peculiar fishes, which are all very small and almost transparent with very little colouring. The sexes are strongly dimorphic, the male possessing a special bony organ lying on the outside of the head which serves for clasping the female. Eighteen species are so far known, occurring in brackish and salt water in Malaya, Singapore, Siam, Borneo and the Philippines, in mountain brooks in Luzon and lowland freshwater creeks in Siam and Luzon, and in freshwater lakes from the Philippines and off Sumatra. It is expected that many more are yet to be discovered.

SCOTTISH LAKE DWELLINGS*

FOR the first time one of the very numerous artificial islands on the Scottish lochs has been examined with a technical skill comparable to that so profitably expended on the crannogs of Somerset and more recently of Ireland. Fortunately, the engineers in charge of the Lochaber Water Power Scheme appreciated the scientific importance of the crannog in the north end of Loch Treig that the scheme had exposed and would destroy. Still more fortunately Prof. Ritchie, then at the University of Aberdeen, was able to take advantage of the opportunity for a thorough investigation of the island's structure.

The crannog proved to differ both in plan and construction from the Glastonbury lake village and the individual lacustrine habitations explored by Munro in Galloway last century and more recently by Hencken in Ireland. While the latter are round, it was rectangular. The basal structure was a framework of squared beams, 65 ft. by 42 ft., founded upon a bed of large stones that had been laid on a natural elevation in the loch floor. Above this, layers of timbers and of earth and stones, each separated by layers of brushwood, birch-branches or heather, and in all nearly 6 ft. thick, supported an upper framework of undressed trunks 57 ft. long by 30 ft. broad. It supported yet another layer of brushwood, above which came the actual dwelling floors, frequently renewed until the total deposit above the upper platform was 3 ft. thick. The timber frameworks were kept in place by a double row of upright piles that the excavator shows cannot have served as a defensive palisade.

Access to the island was not provided by any causeway, but a landing stage was found from which a sloping ladder led up to the island's surface. The report emphasizes the structural importance of the brushwork layers both in distributing the weight of superstructures and in cementing together heterogeneous layers.

Ritchie argues convincingly that the usual accounts of the construction of such islands simply will not work with the Treig crannog, and concludes that its builders must have temporarily lowered the water-level at this end of the loch. Relics were disappointingly scarce. They confirm literary testimony to the occupation of the island in the sixteenth and seventeenth centuries, but nothing unambiguously distinctive of an earlier period was found, though a leather shoe seems to be derived from a Romano-British pattern, and the peculiar technique exemplified in a woollen fabric finds its nearest (but still not exact) parallel in textiles of the Viking Age.

* "The Lake-dwelling or Crannog in Eadarloch, Loch Treig: its Traditions and its Construction", by James Ritchie. *Proc. Soc. Antiquaries Scot.*, **76**, 8–78, with plates IV–XIX and 22 text-figures.

FORTHCOMING EVENTS

(Meetings marked with an asterisk are open to the public)

Saturday, November 28

ROYAL PHOTOGRAPHIC SOCIETY (at 16 Princes Gate, South Kensington, London, S.W.7), at 3 p.m.—Dr. S. O. Rawling: "Sensitometry since Hurter and Driffield" (Hurter and Driffield Memorial Lecture).

Monday, November 30

ROYAL SOCIETY OF ARTS (at John Adam Street, Adelphi, London, W.C.2), at 1.45 p.m.—Mr. W. Allen: "Some Aspects of Insulation", 2: "Sound Insulation" (Cantor Lectures, 2).

ROYAL SOCIETY (at the Royal Institution, Albemarle Street, London, W.1), at 3 p.m.—Lectures in commemoration of the Tercentenary of the birth of Isaac Newton. Prof. E. N. da C. Andrade, F.R.S.: "Newton and the Science of his Age": Rt. Hon. Lord Rayleigh, F.R.S.: "Newton as an Experimenter": Sir James Jeans, O.M., F.R.S.: "Newton and the Science of To-day".

Tuesday, December 1

INSTITUTION OF CIVIL ENGINEERS (at Great George Street, Westminster, London, S.W.1), at 2 p.m.—Mr. J. K. Hunter and Mr. R. W. Mountain: "Hydro-Electric Development, some Economic Aspects".

ROYAL INSTITUTION (at 21 Albemarle Street, London, W.1), at 3 p.m.—Prof. J. C. Drummond: "The History of our More Important Foods", (ii) "Meats".*

Wednesday, December 2

ROYAL SOCIETY OF ARTS (at John Adam Street, Adelphi, London, W.C.2), at 1.45 p.m.—Mr. D. R. Bomford: "Agriculture To-day and To-morrow", 2: "Machinery in Modern Farming".

BRITISH SOCIETY FOR INTERNATIONAL BIBLIOGRAPHY (at the Science Museum, Exhibition Road, South Kensington, London, S.W.7), at 2.15 p.m.—Mr. R. Unwin and Mr. M. C. Haycroft: "Cooperation between Authors and Printers in the Preparation of Copy for Publication".

ROYAL ENTOMOLOGICAL SOCIETY OF LONDON (JOINT MEETING WITH THE GENETICAL SOCIETY) (at 41 Queen's Gate, South Kensington, London, S.W.7), at 3 p.m.—"Methods of Study of Wild Populations" (Speakers: Dr. R. A. Fisher, F.R.S., Prof. Julian Huxley, F.R.S., Dr. C. B. Williams, Dr. George Salt, Prof. P. A. Buxton).

Thursday, December 3

INSTITUTION OF ELECTRICAL ENGINEERS (at Savoy Place, Victoria Embankment, London, W.C.2), at 5.30 p.m.—Lieut.-Colonel K. Edgcumbe: "Standardization as applied to Industrial Electrical Instruments".

Friday, December 4

ROYAL INSTITUTION (at 21 Albemarle Street, London, W.1), at 5 p.m.—Prof. William G. Holford: "The Small House and the Large Town, some Town Planning Problems".

PHYSICAL SOCIETY (in the Lecture Theatre of the Science Museum, Exhibition Road, South Kensington, London, S.W.7), at 4.30 p.m.—Prof. E. N. da C. Andrade, F.R.S.: A lecture on Newton (in celebration of the Tercentenary of Newton's Birth).

Saturday, December 5—Sunday, December 6

ASSOCIATION OF SCIENTIFIC WORKERS (with the support of the BRITISH ASSOCIATION) (at Gas Industry House, 1 Grosvenor Place, London, S.W.1)—Conference on "Scientists of the United Nations and the War Effort".*

Saturday

At 2.30 p.m.—"Allied Scientists" (Chairman: Sir Richard Gregory, Bart., F.R.S.).

Sunday

At 11 a.m.—"Free National and Refugee Scientists" (Chairman: Prof. John Marrack).

At 2.30 p.m.—"British Scientists" (Chairman: Sir John Russell, F.R.S.).

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments on or before the dates mentioned:

LECTURER (MAN OR WOMAN) FOR CHEMISTRY AND PHYSICS, and a LECTURER FOR ENGINEERING SUBJECTS—The Principal, Shrewsbury Technical College, Shrewsbury.

HEADMASTER of Felsted School—The Clerk to the Governors, Mr. Norman Orfeur, Solicitor, Braintree, Essex (December 31).

DIRECTOR of the National Froebel Foundation—The Secretary, National Froebel Foundation, 2 Manchester Square, London, W.1 (February 27)

REPORTS and other PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

Something to Look Forward To: a Suggestion for a New Social Contract. By Lady J. Rhys Williams. Pp. 54. (Cardiff: Western Mail and Echo, Ltd.) [1210

Six-Figure Trigonometrical Tables and Formulæ. Pp. 55. (Dagenham: Ford Motor Co., Ltd.) 1*s.* 6*d.* [1210

University of London: University College. Calendar, Session 1942-1943. Pp. xxv+126. (London: Taylor and Francis, Ltd.) [1310

The Atlantic Charter and Africa from an American Standpoint: a Study by the Committee on Africa, the War, and Peace Aims. The Application of the 'Eight Points' of the Charter to the Problems of Africa, and especially those related to the Welfare of the African People living South of the Sahara, with related material on African Conditions and Needs. Pp. xi+164. (New York: The African Bureau; London: Edinburgh House Press.) 75 cents; 4*s.* [1310

British Rubber Producers' Research Association. Publication No. 24: Thermodynamic Study of the Elastic Extension of Rubber. By L. R. G. Treloar. Pp. 6. Publication No. 25: The Interaction between Rubber and Liquids, 2: The Thermodynamical Basis of the Swelling and Solution of Rubber. By G. Gee. Pp. 8. Publication No. 26: (i) α-Methylenic Reactivity in Olefinic and Polyolefinic Systems, by E. H. Farmer; (ii) The Course and Mechanism of Autoxidation Reactions in Olefinic and Polyolefinic Substances, including Rubber, by E. H. Farmer, G. F. Bloomfield, A. Sundralingam and D. A. Sutton; (iii) Ionic and Radial Mechanisms in Olefinic Systems, with special reference to Processes of Double-Bond Displacement, Vulcanisation and Photo Gelling, by E. H. Thomas. Pp. 24. (London: British Rubber Producers' Research Association.) [1410

The Post-War Home: a Series of Lectures on its Interior and Equipment. (Published for the Royal Society of Arts.) Pp. 120. (London: *The Studio*, Ltd.) 2*s.* 6*d.* net. [2010

British Electrical and Allied Industries Research Association. Technical Report, Reference W/T7: Simplified Electrically Heated Hotbeds. By C. A. Cameron Brown and E. W. Golding. Pp. 24. (London: British Electrical and Allied Industries Research Association.) 1*s.* net. [2010

Ministry of Agriculture and Fisheries. Growmore Bulletin No. 7: Fruit from the Garden. By J. M. S. Potter. Pp. 13. (London: H.M. Stationery Office.) 3*d.* net. [2110

Geological Survey of Great Britain: Scotland. Wartime Pamphlet No. 27: The Oil-Shales of the Lothians—Structure, Area 2: Pumpherston. By Dr. J. G. C. Anderson. Pp. 20. (London: Geological Survey and Museum.) 1*s.* [2110

Other Countries

Bulletin of the American Museum of Natural History. Vol. 80, Art. 2: On the Structure of *Mesoplodon densirostris*, a Rare Beaked Whale. By Henry C. Raven. Pp. 23-50. (New York: American Museum of Natural History.) [2010

University of Cape Town. Communications from the School of African Studies, New Series No. 1: The Bored Stones of Southern Africa, Part 1: Bantu Specimens. By A. J. H. Goodwin. Pp. iv+22. (Cape Town: University of Cape Town.) 2*s.* [2010

Nyasaland Protectorate. Annual Report of the Forestry Department for the Year ended 31st December 1941. Pp. 16. (Zomba: Government Printer.) 1*s.* [2010

Department of Public Instruction, Technical Education Branch: New South Wales. Technological Museum: Curator's Annual Report for Year ended 31st December 1941. Pp. 2. (Sydney: Government Printer.) [2010

Towards a New World-Order, an Indian View. An Address delivered to the Joint Easter Session of Science Associations in Bangalore, April 4, 1942. By D. V. Gundappa. Pp. 32. (Bangalore: Karnataka Publishing House.) [2210

Annual Report for the Year 1941 of the South African Institute for Medical Research, Johannesburg. Pp. 56. (Johannesburg: South African Institute for Medical Research.) [2210

Records of the Geological Survey of India. Vol. 75, Professional Paper No. 16: Bauxite and Aluminous Laterite Occurrences in Jashpur State, Eastern States Agency. By A. K. Dey. Pp. ii+16. (Calcutta: Geological Survey of India.) 4 annas; 5*d.* [2210

Indian Forest Records (New Series). Utilisation, Vol. 2, No. 7: Note on Indian Timbers for Aircraft and Gliders. By V. D. Limaye. Pp. v+168-177. 4 annas; 5*d.* Silviculture, Vol. 5, No. 1: The Problem of the Pure Teak Plantation. (A revision of Bulletin No. 78 of 1932.) By M. V. Laurie and A. L. Griffith. Pp. ii+121+8 plates. 3.10 rupees; 5*s.* 9*d.* (Delhi: Manager of Publications.) [2210

Indian Forest Bulletin (Botany, New Series), No. 109: Hints for Botanical Collectors. By M. B. Raizada. Pp. iii+9. (Delhi: Manager of Publications.) 2 annas; 3*d.* [2210

Survey of India. General Report, 1941, from 1st October 1940 to 30th September 1941. Pp. vi+41. (Calcutta: Survey of India.) 1.8 rupees; 2*s.* 6*d.* [2210

Harvard Meteorological Studies. No. 5: Eclipse Meteorology, with Special Reference to the Total Solar Eclipse of August 31, 1932. By Charles F. Brooks, Sterling P. Fergusson, Herbert H. Kimball, Bernhard Haurwitz, Eleanor Stabler Brooks, Jerome Namias, Charles H. Pierce, Harry Wexler, Edward M. Brooks. Pp. 109. 1.25 dollars. No. 6: Heat Transfer by Infrared Radiation in the Atmosphere. By Walter M. Elsasser; with a copy of the Atmospheric Radiation Chart, second edition. Pp. 107. 1.25 dollars. (Milton, Mass.: Blue Hill Meteorological Observatory.) [2610

Kungl. Svenska Vetenskapsakademiens Handlingar. Serien 3, Band 19, No. 3: Det Stora Nordenskiöldska Järnblocket från Ovifak. Mikrostruktur och Bildningsätt. Av H. Löfquist och C. Benedicks; Pp. 96+2 plates. Serien 3, Band 19, No. 4: Communities of Marine Algae in Subantarctic and Antarctic Waters. By C. Skottsberg. Pp. 92+3 plates. Serien 3, Band 19, No. 5: Die Bothriolepis-Arten der Cellulosa-Mergel Lettlands. Von Walter Gross. Pp. 80+29 plates. Serien 3, Band 19, No. 6: A Spectrophotometric Investigation on Stars in Bright and Dark Regions in Cepheus. By Gunnar Wernberg. Pp. 140. Serien 3, Band 19, No. 7: Die Hydracarinenfauna Südbrasiliens und Paraguays, Teil 1. Von O. Lundblad. Pp. 184+5 plates. Serien 3, Band 19, No. 8: Bau und Entwicklung der Gnetum-Gametophyten. Von Folke Fagerlind. Pp. 55. Serien 3, Band 20, No. 1: General Morphology of the Lateral Sensory Line System of the Head in Fish. By Nils Holmgren. Pp. 46. Serien 3, Band 20, No. 2: Die Hydrocarinenfauna Südbrasiliens und Paraguays, Teil 2. Von O. Lundblad. Pp. 176+7 plates. (Stockholm: Almquist and Wiksells Boktryckeri A. B.) [2710